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LEWIS STEPHEN PILCHER, MD., LL.D.

of New York

With the Association of

JAMES TAFT PILCHER, B.A., M.D.

and the Collaboration of

W. SAMPSON HANDLEY, M.S., M.D., F.R.C.S.

of London

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THE MANAGEMENT OF ADVANCED CANCER OF THE STOMACH

BY NATHAN W. GREEN, M.D.

OF NEW YORK, N. Y.

THE purpose of this article is to show what effort has been made in a non-surgical way, or in a physiotherapeutic way, combined with surgery, in the control of cancer of the stomach during the ten years previous to 1925. The study is based upon experience during the past four years while in charge of the Gastric Service at the Memorial Hospital, and covers one hundred and twenty-one cases. It deals principally with what may well be termed advanced inoperable carcinoma of the stomach. The study of this condition has presented one of the most interesting and at the same time one of the most difficult problems with which the physician and surgeon has to deal, and is wrapped up with the diagnostic means, and with the treatment, both medical, palliative, and surgical. Although there has been some amelioriation in some instances, the end-results have been far from encouraging. Yet we find cases that have led us to hope confidently that at some future day the outcome may be well worth the combined efforts devoted to the subject. Looking back over this field, we see pass in review a host of therapeutic agents marshalled to cope with this condition. Occasionally procedures appear to have been attempted which seem to have submerged the humanitarian phase of the problem. In our work we were unwilling to duplicate or to approximate these. We doubt if there is any clinic where material effort is being made in this question of advanced cancer where more is being accomplished than in this country. We do not wish to lead our readers through a mire of ill-observed and immaturely reported material. From a patient review of the literature of the past ten years we have found in many instances that the conclusions were founded upon observations that were not checked up by all available methods of certainty. Many claims of cure that led to hope have not been of cases proven by microscopical section. This criticism may also be made in some of our own cases, our excuse being that they were in too enfeebled a condition to warrant complication at the time of operation by taking a specimen for biopsy. When a reasonable doubt exists, we do not press the claim. Some authors have apparently felt that an X-ray diagnosis was sufficient for a scientific paper. We cannot find one case of inoperable carcinoma of the stomach *proven by biopsy* which has recovered after physio-

therapeutic treatment. Many have apparently been benefited for a short time, but all have either not been reported further, or have died.

What then is the problem of inoperable carcinoma of the stomach? Is it not to make the inoperable case come under operability by the aid of physiotherapy and to relieve pain, and add a few months to the patient's existence?

Even at the operation of a gastro-enterostomy one hesitates to cut into a malignant growth for a biopsy for fear of spreading metastases. Sometimes a gland in the gastrocolic omentum may be removed. The X-ray, history, tumor felt through the abdominal wall, vomiting of blood, melena, wasting—all together or separately, are not sufficient for a scientific diagnosis. These, together with the direct inspection of the viscus and glands, are many times sufficient; but modern thought requires a microscopical examination before the case can without peradventure be admitted to the class of surely carcinoma, surely cured.

Is it a wonder, then, that these patients may go for months under medical treatment before the true nature of the disease is made clear? The best treatment for cancer of the prepyloric area is to teach the medical profession to make an early diagnosis of a really surgical condition. Given an early case, surgery gives the best hope of cure. Given a moderately advanced case, surgery plus irradiation is indicated, and effects some palliation. Given an advanced case, the patient's psychology is sustained by irradiation. The pains are sometimes relieved by irradiation, and lesser surgical procedures may be brought in to aid in prolonging life. In this class lies the utility of a gastro-enterostomy or jejunostomy under local anæsthesia.

In the literature that has been reviewed, there are numerous claims for cure after one kind or another of irradiation. Many of these claims have been scrutinized, but have been left out as obviously not substantiated by sufficient proofs, and the proofs presented have not been suitably evaluated. One surprising article reports two out of three cases purporting to be stomach cancer well four and a half and seven years after inception of treatment by fractional X-ray, and not even was an inspectional incision made, not to mention a microscopical report! The diagnosis appeared to be based largely on the röntgenogram.

In reviewing these articles, it is clear that the scientific background of the various observers differs widely, and we fancy some would not have made their observations public had they been better trained. The late diagnosis is a reproach to the medical profession, but the early diagnosis in a series of X-rays for all gastric conditions is exceedingly rare (Christian).

It is almost vain to speak of the scientific side; that is best placed in the hands of the laboratory worker.

In cancer of the stomach, we are dealing with cancer in a much covered organ, where early involvement is so insidious that it is shrouded in a mass of indefinite symptoms, almost no one of which is pathognomonic of the disease in question. We do not know the predisposing cause of stomach

cancer. We do not find often the shadow of an early filling defect, and we have but a single organ, wonderfully concealed, to deal with.

An analysis of the histories of the 122 cases observed at the Memorial Hospital shows that 82 were males and 39 females. The age of the patients is shown in the following table.

Number of cases between 20 and 30	3
Number of cases between 31 and 40	9
Number of cases between 41 and 50	28
Number of cases between 51 and 60	45
Number of cases between 61 and 70	32
Number of cases between 71 and 80	5

The oldest patient was 79, and the youngest 25.

Of these cases, 92 gave a history of weakness, and 108 of loss of weight. The appetite was poor in 61 cases. Thirty-one showed anæmia. In 81 a definite mass was present, and in 91 a sentinel node. Twenty-three cases had pyorrhœa. Eleven showed an enlarged liver. The physical findings were corroborated by X-ray examination in 90 cases. Eighteen showed retention. In four there was a positive Wassermann. In three, blood was present in the stools. The histories revealed that 40 operations were performed, some of which were done previous to the patients coming under our care. There were 22 gastrojejunostomies; 8 resections. Two pylorectomies were done in the hospital; 4 jejunostomies, and 4 gastrostomies. The location of the growth was in the cardiac portion 19 times; in the lesser and greater curvature, 7; in the lesser curvature alone, 20; in the prepyloric region 45 times. There were two cases of linitis plastica; and ten of diffuse carcinoma. Of these cases, 11 were recurrent. Of the treatment they had been subjected to, 18 cases had received 1 X-ray treatment; 21 received 2 X-ray treatments; 7 received 3; 13 received 4; 3 received 5; 3 received 8; and 1 received 18. Twelve cases each received 1 radium treatment; 2 cases received 2 radium treatments; 2 cases received 5 radium treatments, and one case received 10 radium treatments. One case had 4 X-ray and 1 radium treatments; one case had 4 X-ray and 5 radium treatments, and another had 3 X-ray and 2 radium treatments. Some form of surgical procedure with the implantation of radium emanation in the growth was performed in 8 cases. Most of these operations were gastro-enterostomies. In making a diagnosis it has been apparent that one must depend more upon the story of the patient than upon the X-ray or physical findings. When the physical findings are present, the disease has advanced far. Christian,* in a recent article, says that "Few cases of cancer are unexpectedly revealed by Röntgen-ray examination in patients whose full histories and systematic general physical examinations are recorded." This is a very significant observation coming from one whose authority is so worthy of respect. The general appearance of the patient, together with a history of weakness and loss of weight, is very valuable in coming to a diagnosis. Loss of appetite is not always present.

* J. A. M. A., 1924, vol. lxxxii, p. 2011.

It is not always possible to corroborate our operative findings by a biopsy, as some patients are too sick to warrant any complication of the operation by increasing it. A simple gastro-enterostomy may be all they will stand, and sometimes only a jejunostomy. In very emaciated cases with gastric retention, a simple jejunostomy may prolong the life for months.

Too much dependence on X-ray diagnosis is to be viewed with caution, and it is better when gastric symptoms of an obscure nature persist over any length of time that the patient be given the benefit of an exploratory inspection. In no other way do I think that the majority of gastric carcinomata can be discovered early enough for cure.

I wish to express my thanks to Drs. Douglas Quick and William B. Coley for the privilege of including some of their cases in this series, and my appreciation to Dr. Ralph Herendeen for his thorough coöperation from the standpoint of the röntgenologist and also from the standpoint of the radiotherapeutist. To Dr. Theodore H. Allen, an experienced gastro-enterologist, I am indebted for material aid in diagnosis in the Wednesday morning clinics.

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ABDOMINAL PUNCTURE IN THE DIAGNOSIS OF ACUTE INTRAPERITONEAL DISEASE*

By Harold Neuhof, M.D.
and
Ira Cohen, M.D.
of New York, N. Y.

Despite the vast numbers of operations that are performed for acute intraperitoneal disease, improved methods in the pre-operative diagnosis have not been evolved in recent years. As a result, the indications for or against operation are not always clear, the history and the usual physical examination not infrequently fail to establish a positive diagnosis, and the choice for or against an exploratory laparotomy may rest on relatively scant evidence. The exact proportion of cases in which the diagnosis remains in doubt cannot be stated, but in our own experience we would place it between five and fifteen per cent. In some of the cases in this group, the subsequent course proved that laparotomy had not been indicated. In other cases, non-intervention proved to be equally incorrect. Were it solely a matter of scientific imperfection in diagnosis, this situation could be termed merely unsatisfactory; unfortunately, however, errors in diagnosis and indication have occasionally led to unnecessary complications and even to death in some instances. Any safe method that can aid in the diagnosis of acute intraperitoneal disease should therefore be welcome. From our experience we are convinced that abdominal puncture is a safe procedure that is often of invaluable aid in the diagnosis of acute intra-abdominal lesions.

The use that has already been made of abdominal puncture in acute abdominal disease can be briefly sketched for the literature contains only scattered references to the method. In 1906, Solomon [1] devised an ingenious but rather complicated apparatus that he recommended for abdominal puncture. It consists of a needle within a trocar, through which a ureteral catheter is passed into the peritoneal cavity. Solomon described a few cases in which the procedure appeared to be of value. Abdominal puncture to determine an appendiceal abscess is mentioned by Sahli [2] in his Manual of Diagnosis. In 1912, Panichi [3] reported the results in two cases, together with an examination of the aspirated fluid and autopsy records. At a meeting of the New York Surgical Society a number of years ago, Lilienthal suggested the use of exploratory puncture for the diagnosis of gonococcus or pneumococcus peritonitis. Denzer [4] devised a trocar with capillary tube for the study of peritoneal fluids in infants, and encountered a few instances

* The material for this paper is derived from the surgical services of Doctors Lilienthal, Elsberg and Moschcowitz at the Mt. Sinai Hospital, from the First Surgical Division of Bellevue Hospital, from the authors' services at Montefiore Hospital and their private practice.

in which peritonitis was unexpectedly disclosed by the use of the instrument. He believed that fluid could be more readily obtained by a capillary tube than by ordinary aspiration. The conclusion that can be drawn from the literature is that abdominal puncture has proved of some diagnostic value in a few scattered cases.

About five years ago we began to use abdominal puncture for diagnosis. Our first efforts were in the direction of establishing a satisfactory technic and of determining the frequency with which fluid would be found on preoperative puncture when it was proved to be present at operation. Thus, during a short period, abdominal puncture was employed as a routine in most cases of acute peritoneal conditions that came to operation. The punctures were performed under anæsthesia just prior to laparotomy. In the later series of cases, abdominal aspiration was used in those instances in which the diagnosis was uncertain or could not be established by the usual methods of physical examination.

The subject will be taken up as follows: (1) The technic of abdominal puncture. (2) The safety of the method. (3) The significance of negative punctures. (4) Contra-indications. (5) Value of abdominal puncture in diagnosis and prognosis, and in the indications for and contra-indications to operation.

Technic.—The method we employ consists of the use of a lumbar puncture needle to which a ten or twenty c.c. syringe fits accurately. The usual preparation of the skin of the abdominal wall is made. Either freezing of the skin with ethyl chloride or anæsthetization of the proposed tract of the needle with novocain is practiced. A small incision in the skin is made for two reasons: first, to avoid carrying bits of skin into the track of the needle, and, secondly, to preserve the delicacy of touch when the needle is introduced. The usual site of election is a point at or below the level of the umbilicus to the right or left of the median line. We have generally punctured through the rectus muscle near its outer border, but puncture can be made lateral to the muscle. The site of puncture can often be placed in the line of the probable laparotomy incision. Of course aspiration will not be performed over the situation of a palpable or questionable mass. Thus if puncture is to be employed in a case of suspected appendicitis abscess with peritonitis, it should be done in the left lower quadrant. After the skin incision, the lumbar puncture needle with stylet in place is introduced perpendicularly with slow even pressure. In puncturing through the rectus muscle the resistance of the anterior sheath is felt. Passing through the muscle, a similar resistance of the posterior sheath is encountered, and then the needle enters the peritoneal cavity. The stylet is withdrawn and the syringe attached. While suction is being maintained, the needle is pointed in various directions. If no fluid is immediately found, the vacuum in the syringe should be maintained for a time, for we have withdrawn fluid in some instances only after an interval of several seconds. The latter is particularly true when the amount of intraperitoneal fluid is small. It is of practical importance to note that fluid is

more frequently encountered just beneath the anterior parietal peritoneum than in the depths of the abdominal cavity. Therefore suction should be especially maintained as the needle is withdrawn, in cases in which fluid has not been encountered up to that time. In some instances only a drop of fluid may be withdrawn and may be missed unless sought for in the lumen of the needle or on the surface of the plunger. A dry tap should not be assumed merely because fluid is not at once evident. We wish to emphasize the fact that we have upon a number of occasions obtained the necessary information for a positive diagnosis from a single drop of fluid.

Safety of the Method.—Theoretically, a possibility of injury to a loop of gut exists. We are convinced, however, that this is only theoretical in acute abdominal conditions. In the first place this accident has not been seen by us in an experience of more than a hundred cases. The majority of these were subjected to operation and evidence of trauma to the intestine has never been noted. The subsequent course of those not operated upon in no way suggested a visceral injury. Secondly, the use of abdominal puncture for pneumoperitoneum has demonstrated the absence of danger in introducing the needle.[5] Finally, we have attempted to puncture loops of exposed intestine with a lumbar puncture needle and have been unable to do so unless the gut is held fixed. There may possibly be some danger in the use of a very fine needle, but there is every reason to believe that none exists with the ordinary small-sized lumbar puncture needle. We wish to emphasize here, however, that abdominal puncture is not safe in subacute or chronic intra-abdominal lesions, in which a loop of intestine may be fixed.

Whether the following history can properly be included as an example of injury to a fixed loop of gut is doubtful, but it is reported for the sake of completeness. A middle-aged man was admitted to the hospital with a ten-hour history of generalized abdominal pain. With the onset of pain, a left inguinal hernia of long standing became irreducible. Obstruction, however, was not complete. Because of the very marked generalized abdominal rigidity a peritonitis was suspected and abdominal puncture was done in the left lower quadrant. This proved negative. At operation a sliding hernia of the sigmoid was found, surrounded by purulent exudate. The free peritoneal cavity was not entered. A virulent post-operative gas gangrene of the wound and abdominal wall developed. The patient died three days after operation. At the post-mortem examination there was found, in addition to the gas gangrene of the abdominal wall, adherent gangrenous loops of small intestines and sigmoid, with a perforation and peritonitis. It is probable that this was the primary condition and that the irreducible hernia was due to increased intra-abdominal tension. The perforation was not at the site of abdominal puncture. The case is presented because it is the only one in which there existed any possible relation between abdominal puncture and an intestinal lesion.

The Significance of Negative Abdominal Puncture.—Before discussing the value of abdominal puncture in diagnosis, the proportion of negative

punctures in the presence of fluid should be stated. There were negative punctures in the presence of fluid demonstrable at operation in four cases in our series. Therefore, with the technic we employ, *a negative puncture does not exclude the presence of fluid.* Thus in a case in which a peritonitis is suspected a negative puncture in no way justifies the elimination of that diagnosis. On the other hand, a negative puncture in cases of peritonitis in which the pneumococcus or gonococcus is suspected, may be of some value. In such instances, with the diagnosis in doubt, operation would probably be performed, whereas it would not be carried out if the puncture were positive and revealed either of these organisms. There have been some instances in which a negative puncture has supported the clinical impression of absence of an intraperitoneal lesion, and to this extent has been of value. For example, in a recent case the wheel of a wagon ran over the left lower chest of a boy. He was in moderate shock, the pulse-rate was elevated, the upper abdominal wall tense. There was not enough evidence to warrant the diagnosis of an intra-abdominal lesion (rupture of the spleen), and the case was considered one for observation unless the abdominal puncture was positive. The puncture was negative, and the further course demonstrated that no gross intraperitoneal lesion had existed. In general, however, a negative puncture is of no diagnostic significance. We cannot stress too strongly the necessity for a clear appreciation of the meaning of a negative puncture. *If in any given case the decision has been reached that operation is indicated, whether for a traumatic or an inflammatory intraperitoneal lesion, operation should be proceeded with absolutely regardless of a negative puncture.* It is a positive puncture under such circumstances that might lead to non-operative treatment, never a negative puncture. Unless this viewpoint is clearly kept in mind, operation might be withheld in cases in which it is indicated.

Contra-indications to Abdominal Puncture.—The first obvious contra-indication to abdominal puncture exists when the diagnosis or the clinical indication is sufficiently clear without it. The only other contra-indication has already been pointed out, namely, a chronic or subacute intraperitoneal lesion (neoplasm, tuberculosis or other chronic inflammation) that may fix a loop of intestine. When a mass is present in an acute peritoneal infection, puncture should not be performed in that region because of the danger of injuring a fixed loop of intestine.

The diagnostic value of abdominal puncture consists, first, in the demonstration of the existence of fluid, whether blood, serous effusion, or pus, and, secondly, in making possible examination of the fluid that is withdrawn. Other than blood or bloody fluid obtained in traumatic cases, both the macro- and microscopic characteristics must be evaluated. For example, it is the organism found in the microscopic examination of spreads of the aspirated fluid that establishes the diagnosis of a pneumococcus or a streptococcus peritonitis. In a case of rupture of the bladder the urinous odor of the fluid obtained by puncture gave the clue. In acute pancreatitis we have found that the fluid sometimes has a typical beef juice color and oily appearance.

In four cases of verified pancreatitis the fluid was characterized by a high content of polymorphonuclear leucocytes (85 to 90 per cent.) and at the same time an absence of bacteria in the spreads. A yellow fluid with sour odor aided in establishing the diagnosis of a perforated gastric ulcer in one instance. Enough has been said to indicate that the diagnostic value of a positive puncture in general depends at least as much upon a study of the fluid as upon merely obtaining fluid.

The proven diagnostic value of the method in our hands is best illustrated by taking up the different groups of cases in which it has been employed. Albeit convenient, this is a somewhat artificial manner of treating the subject, because in not a few instances the group into which a case fell was only determined by the abdominal puncture.

The *traumatic group* of cases will be first considered, and some illustrative cases presented. Abdominal puncture was of diagnostic value in a number of instances. In a case of stab wound of the left flank, seen shortly after the accident, there was very slight evidence of an intraperitoneal lesion. Blood was obtained by abdominal puncture and this finding was the determining factor in the decision to operate. A penetrating wound of the descending colon was found. Of four cases of rupture of the spleen, operation in one was performed chiefly because blood was withdrawn on puncture. This patient was seen within two hours of the accident and presented only vague clinical evidence of an intra-abdominal lesion at the time. In another case the clinical picture was interpreted as one of an inflammatory focus in the left upper abdomen:

The boy entered the hospital two days after having fallen against the curb, striking his left lower chest. His temperature was 102.6, there was rigidity and a rebound sign throughout the abdomen, most marked in the left upper quadrant. The white blood count was 22,000, with a differential count of 84 per cent. of polymorphonuclear cells. A rupture of the spleen was not considered in the diagnosis. Puncture of the general peritoneal cavity was negative, but aspiration of the left subphrenic region disclosed blood. A rupture of the spleen with perisplenic hæmatoma was found at operation, no blood being present in the free peritoneal cavity.

In a case of injury to the right lower chest with very questionable evidence of a lesion of the liver, blood found at puncture led to an exploratory laparotomy. A superficial tear of the liver surface was found, from which the bleeding had ceased at the time of operation. This is the only case in which a positive abdominal puncture, although verified at operation, led to an unnecessary laparotomy.

In the following case the evidence favored an intrathoracic lesion:

Bullet wound with entrance just below cardiac apex, X-ray showing the bullet lodged high up in right lobe of liver or in lower lobe of right lung. The opinion of the radiologist was that the peritoneal cavity was not penetrated. The abdominal wall was rigid, however, and an intraperitoneal lesion was suspected. There was blood on abdominal puncture; at operation, penetration of the diaphragm and liver and a large amount of blood in the peritoneal cavity were encountered.

Another interesting example was a case of fracture of the pelvis in a patient with peritonic manifestations. Catheterization disclosed urine free

from blood. The diagnosis therefore was a probable retroperitoneal hemorrhage. However, fluid with a urinous odor was obtained by abdominal puncture. Therefore operation was performed despite the negative urine found by catheterization. An intraperitoneal rupture of the bladder was found at operation, the tear being at the fundus.

Turning now to the group of *peritonitis* cases, there was a surprising number of instances in which positive abdominal puncture was of decisive value not only in the diagnosis, but also in the prognosis. The first group is that of *pneumococcus peritonitis,* all in children. The value of puncture in the diagnosis of this disease is so evident, that we need only refer briefly to it here. There have been ten or more cases under our observation in the past five years. In some the diagnosis was probable without puncture, in others, doubtful. In two or possibly three, the diagnosis was acute appendicitis, and in these the result of puncture led to the correct treatment—namely, to withhold operation. It would be out of place to discuss here the surgery of pneumococcus peritonitis, but an illustrative case will demonstrate the value of puncture in the diagnosis and in the indication for treatment: A girl presented the picture of a probable pneumococcus peritonitis. Abdominal aspiration revealed pus containing the organisms. Under observation the process localized, a large pneumococcus abscess was drained, and the patient recovered.

The next group of cases is that of *streptococcus peritonitis.* There were several cases in this group, chiefly in children, in which the diagnosis of the nature of the peritonitis was in doubt until cleared up by abdominal puncture. It is safe to say that nearly all of them would have been subjected to an unnecessary laparotomy with a tentative diagnosis of acute appendicitis with peritonitis if puncture had not been employed. It is, of course, possible for a pure streptococcus peritonitis to be secondary to an infective focus that is remediable by operation, but in the gravely ill, septic patients who have come under our observation and have died, autopsy has invariably demonstrated that the streptococcus peritonitis was part of a general sepsis and was not derived from an intraperitoneal pus focus. In two striking cases the saving of life can be largely ascribed to the disclosure of a streptococcus peritonitis by puncture and the consequent withholding of operation.

A child was admitted in a septic state, with an acutely inflamed throat and the clinical picture of a peritonitis. The admission diagnosis was acute appendicitis. It was evident that even a simple laparotomy would be very poorly withstood by the child in its desperately toxic state. The turbid fluid obtained by abdominal puncture revealed chains of streptococci in the stained spreads. Conservative treatment was instituted. For several days the septic state continued, the blood culture was positive, but the abdominal manifestations gradually cleared up. A pneumonia developed, followed by an empyema that was drained, and the child recovered.

The second case was perhaps more remarkable:

A girl of ten presented the clinical picture of an acute, virulent peritonitis, in which the diagnosis of acute appendicitis had been made. The abdominal condition had apparently followed a sore throat. Her condition was desperate, and the only justification

for a laparotomy would have been a reasonable assurance of the existence of an appendicitis. By abdominal puncture, cloudy fluid containing streptococci was withdrawn. Treatment of the septic state was instituted. Blood culture proved positive. After several days, drainage of a localized intraperitoneal collection of pus was performed, metastatic abscesses in various parts of the body—tibia, ankle-joint, pleura, etc.—were drained, and the patient recovered.

The importance we attach to the finding of streptococci alone in the smear of aspirated fluid, and the contra-indication to operation in doubtful cases, based on such a finding, is supported by a study of the culture of peritoneal fluids. Through the courtesy of Dr. F. S. Mandlebaum we looked up the records of such cultures over a period of three years at Mount Sinai Hospital, during which time there were more than 200 that were studied. Just twice was a pure culture of streptococcus obtained in acute appendicitis. These may not be the only instances in which the streptococcus was the sole organism, for cultures are not taken at all operations. From this report and from our own experiences, however, our conclusion is that a case of appendicitis clinically so obscure as to call for puncture and in which streptococci alone are to be found in spreads of the fluid obtained must be a very rare combination. As in any other diagnostic procedure, abdominal puncture is but part of the composite picture, but where it is called upon as an aid, the finding of streptococci has in our hands been a signal to withhold operation. This conclusion has been supported by our results, in which non-operative treatment, in the early stages of a streptococcus peritonitis at any rate, has unquestionably resulted in the saving of life in several instances.

Turning to a group of seven cases of *acute pancreatitis*, abdominal puncture proved of great value in all but one. These patients came under observation with the clinical picture of acute or subacute intestinal obstruction with some signs pointing to a peritonitis. Although acute pancreatitis was suspected in some, the disclosure of fluid having the characteristics that have already been mentioned clinched the diagnosis. In one patient who would have ill withstood an exploratory laparotomy, the result of abdominal puncture was of decisive aid in the decision to defer operation.

This was a thick-set man, with a greatly distended abdomen and a short history of intestinal obstruction. His circulation was collapsed, his skin cyanotic. Although the diagnosis of an acute pancreatitis was entertained, an acute cholecystitis or an intestinal obstruction could not be excluded. Abdominal puncture disclosed fluid resembling beef juice containing 87 per cent. polymorphonuclear leucocytes, but no bacteria. Under conservative treatment the fulminating abdominal manifestations gradually subsided; fulness and œdema developed in the left lateral abdominal region. On the eighth day after admission an extraperitoneal incision was made and a peri-pancreatic abscess, with a cavity lined by necrotic fat and containing sloughs of pancreas, was drained. The patient made a slow recovery, with discharge of pancreatic sloughs from the wound.

The one case of proven acute pancreatitis in which abdominal puncture did not reveal the typical fluid should be mentioned, although the existence of a non-bacterial peritonitis was demonstrated. A stout, elderly woman came under observation with the picture of an intestinal obstruction, and pneumonia of both lower lobes (verified by X-ray). In the diagnosis, acute cholecystitis and acute pancreatitis were considered. Puncture on the right side of the abdomen was negative. The next day puncture to the left

of the umbilicus revealed thin pus containing 95 per cent. polymorphonuclear leucocytes, but no bacteria in the spreads. The fluid did not present the appearance we consider typical of the peritoneal exudate in acute pancreatitis. At operation, under local anæsthesia, an incision in the right upper quadrant was made, fat necrosis characteristic of pancreatitis was found, but no purulent fluid was encountered. A cholecystostomy was performed, the left side of the abdominal cavity was not explored. It must be assumed that the purulent fluid was encapsulated on the left side; the subsequent course of the case indicated a spontaneous disappearance of this exudate.

Unless the peritoneal exudate is the oily, beef juice like fluid typical of cases of pancreatitis, all that can be said of the finding of preponderating polymorphonuclear cells and no bacteria in an abdominal puncture fluid, is that the patient is suffering from an aseptic peritonitis. If this fits in with a clinical picture of pancreatitis the diagnosis is justified. However, in the following case, we were misled in our interpretation.

A woman suffering from diabetes presented the clinical picture of an acute incomplete intestinal obstruction with pain and tenderness over the left lateral abdominal region. During several days' observation the conclusion was reached that the lesion was an acute pancreatitis. Abdominal puncture disclosed cloudy fluid containing 80 per cent. polymorphonuclears but no bacteria. The symptoms persisted and at operation there was found a carcinoma of the colon with incomplete intestinal obstruction and secondary peritoneal exudate.

Clinically, the above instances are a borderline between the group in which the diagnosis of a peritonitis is clear and the group in which that diagnosis cannot justifiably be made by the usual physical examination. In the past five years we have seen several cases belonging to the latter group. It is noteworthy that in these cases abdominal puncture was of decisive value. Two striking instances will serve as illustrations:

In the first a colored woman was admitted with a history of frequent vomiting and high fever. She was delirious and it was impossible to make a satisfactory physical examination. Abdominal puncture disclosed considerable cloudy fluid containing streptococci. Operation was not performed. The septic state rapidly grew worse and the patient died the same day. The autopsy revealed a phlegmonous gastritis and a generalized streptococcus peritonitis.

The second case was a man, fifty-seven years old, with a history of acute abdominal pain, preceded by sore throat, and the presence of pronounced icterus. The provisional diagnosis was acute pancreatitis, although the history of sore throat raised the question of a metastatic peritonitis. The abdominal puncture fluid contained polymorphonuclear cells and streptococci. The patient died of streptococcus peritonitis. At autopsy the source of the infection was not found.

A diagnostic value of abdominal puncture to which we have not as yet referred, exists in some cases in which the diagnosis of a peritonitis can be readily made and the indications for operation are clear, but in which the nature of the lesion is obscure. In a number of instances the character of the fluid obtained by aspiration has aided in clearing up the diagnosis and has thus enabled us properly to place the abdominal incision. As an example we may cite a case in which the diagnosis was acute appendicitis and spreading peritonitis. Abdominal puncture under anæsthesia disclosed fluid character-

istic of a perforated gastric ulcer; this was the lesion found upon opening the abdomen in the right upper quadrant.

Finally, there are many acute intraperitoneal lesions in which we have not had the opportunity to test the diagnostic value of abdominal puncture. It is logical to believe that in such conditions as perforations of hollow viscera (in which air might be obtained by puncture), ruptured ectopic gestation, or twisted ovarian cyst, abdominal puncture will prove of as much diagnostic value as in the intra-abdominal lesions in which we have employed the method.

SUMMARY

1. Exploratory abdominal puncture is a simple, safe, and valuable aid in the diagnosis of obscure acute intra-abdominal disease.

2. It serves to establish the diagnosis of a traumatic or inflammatory intraperitoneal lesion in some cases in which the diagnosis cannot otherwise be made.

3. In other instances abdominal puncture offers conclusive information as to the source and nature of a peritonitis, and thus aids directly in arriving at the therapeutic indication as well as the prognosis.

4. In the peritonitis group abdominal puncture is of especial value in establishing the diagnosis of the pneumococcus and streptococcus infections.

5. Abdominal puncture is contra-indicated in any subacute or chronic intra-abdominal disease in which a loop of intestine may be fixed.

6. A negative abdominal puncture does not exclude the presence of fluid and should therefore never be interpreted as a contra-indication to operation in suspected peritonitis or traumatic visceral lesions.

7. Abdominal puncture should be employed as an aid to diagnosis in every obscure acute intraperitoneal lesion for which operation may be indicated.

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LOCAL VERSUS GENERAL ANÆSTHESIA FOR UPPER ABDOMINAL OPERATIONS*

A COMPARISON OF POST-OPERATIVE CONDITIONS

By J. Tate Mason, M.D.
of Seattle, Wash.

As a basis for this paper 100 consecutive upper abdominal operations have been studied. Fifty of these were performed under ether and fifty under local, or local and gas anæsthesia. That the information regarding this group of cases might be obtained with the greatest possible accuracy, a group was selected from within a twelve-month period. All operations were performed by one surgeon, in the same hospital, with practically no changes in the surgical staff or the floor nurses.

Local anæsthesia, as compared with anæsthesia by general narcosis, has proved in our experience to possess advantages of cardinal importance. Notwithstanding the relatively low mortality from ether and chloroform anæsthesia, the damage done to kidney, liver, and lung tissue by general narcosis as compared with the effects on these organs by local injections, is considerable. Since the institution of relatively non-toxic drugs, novocaine, procain, etc., in local anæsthetic work, degenerative changes in parenchymatous organs are negligible, and pneumonia, bronchitis, nausea, vomiting, and shock are conspicuous by their absence in the post-operative period. At a time when the vital forces are most called upon, when the strength is at lowest ebb, ether anæsthesia tends to reduce still further those forces. Prolonged vomiting causes dehydration, and acidosis results.

General anæsthesia was induced by the inhalation of nitrous oxide and oxygen and continued with ether given by the open or drop method, using an Esmarch inhaler. The local anæsthesias were induced by infiltration of the anterior abdominal wall, followed by anterior splanchnic block. The solution used was a 0.5 per cent. solution of procain in 0.6 per cent. sodium chloride, with 9 drops of adrenalin chloride added to each 100 c.c.

In the local anæsthesia cases there were a number of factors which we soon found had to be considered, in addition to the administration of the anæsthetic solution to the nerves supplying the region to be operated upon.

Our first observation was that individual sensibility to pain plays a more important part in a successful local anæsthetic than had been expected. Patients who have a considerable layer of fat are hard to anæsthetize completely. In patients with acutely inflamed gall-bladders who have had local peritonitis in the upper right quadrant, the skin has been found hypersensitive.

Apprehension probably is the greatest factor in a patient's response to painful stimuli. Women are more sensitive than men, while babies, old people

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and some individuals, as men who live out of doors, are less sensitive to pain than others.

A patient who reaches the operating room with the greatest degree of confidence and calmness is much more likely to permit an operation under local anæsthesia to be carried through to a successful conclusion. If the patient is nervous and partially exhausted the conditions for local anæsthesia are extremely unfavorable. Rest, sleep, a high glycogen reserve, and a narcotic administered one hour before operation, are valuable in securing this desirable condition of calmness and euphoria.

For the rest, these patients entered the hospital early in the afternoon of the day before operation, so that at least four hours of rest might be obtained. To insure a high glycogen reserve a light supper was given at 5 P.M., and later, between 9 and 9.30 a tray containing four crackers, three ounces of strained honey, and one glass of milk to which had been added a teaspoonful of lactose and 10 grains of veronal, was taken to the patient with instructions to take at once. This increases the glycogen reserve, adds 650 calories of food with very little residue, and furnishes a mild somnifacient which in most cases we found lasted over the greater part of the night.

Morphine and scopolamine modify to a large degree the sensibility to pain. We believe it is 10 per cent. more efficient when given hypodermically in a solution of magnesium sulphate. It establishes favorable conditions for the necessary manipulations of the anæsthetic procedure. It does away with the extreme apprehension some of these patients have. We have not seen any harmful effects from the administration of 1/6 grain of morphine and 1/150 of scopolamine. Up to the present this dose has been given in the Clinic over three thousand times, without a single unpleasant experience.

The patients reach the surgery in a very comfortable frame of mind. We feel that it has been helpful to have them met there by a girl with a pleasing personality. With a reassuring word she makes them comfortable on the operating table, and if possible, diverts their attention from the operation.

We have found it a great mistake to ask the patients if they are being hurt—and still another error has been to do anything that causes discomfort without telling them beforehand. For a time we put small pledgets of cotton in the patients' ears to prevent their hearing the necessary noises and conversation around the operating table. This routine has been abandoned because some patients who were resting comfortably before became nervous and excited as soon as they realized that something had been done to prevent their hearing acutely.

In a comparison of 40 cholecystectomies in which 20 were done under local anæsthesia, we found these interesting facts: Practically no more time was required for operation under local than under general anæsthesia. Practically the same total quantity of morphine was used after operation. Fifteen of the 20 ether cases vomited and most of them for a period of two or three days, whereas only 8 of the 20 local cases vomited at all, and these with one or two exceptions for but one day. The post-operative stay in the hospital

averaged four days less for those patients whose operations were under local anæsthesia. Gas pains were less frequent and less severe in the local cases.

In 40 gastro-enterostomies in which 20 were performed under local anæsthesia, an average of only six minutes longer was required for local than for ether operations. Gas pains and vomiting were more frequent and more persistent after ether. Practically no difference was present in the quantity of morphine used after operation.

A comparison of the total number studied, 100 upper abdominal operations, with 50 performed under local, showed the following points of interest: An average of only eight minutes more was required for each operation under local than for each of the 50 under ether anæsthesia. The average temperature for the first week after operation was below 99 degrees F. in local cases and above 99 degrees F. in ether ones. The average stay in the hospital after operation was three days less for the cases under local anæsthesia. Of the local anæsthetic patients only 18 vomited, while 33 of the ether patients vomited. Also, in the latter vomiting was more marked and more persistent. Only 19 of those having a local anæsthetic against 30 of the ether patients suffered gas pains.

Severe shock was experienced only once in this series, and mild shock four times. This occurred each time after ether anæsthesia. There was no surgical shock after anæsthesia by local injections. Bronchitis was met with in 11 patients taking ether and in 3 after local anæsthesia. There was one pneumonia case. This patient, who was fifty-nine years old, had an acute gall-bladder and bilateral pyelitis. Operation was under local anæsthesia and was successful from the operative standpoint. The patient died eight days after operation—the only death of this series. There was no hernia or phlebitis.

Statistics are very apt to be misleading, and many of us are rather skeptical when it comes to accepting them whole-heartedly. With this knowledge in mind we asked the supervising nurses in whose care these patients have been to express their candid opinions concerning the post-operative condition of abdominal cases done under local injections, as compared with those performed under ether anæsthesia. They have been unanimous in their expressions of favor for local anæsthesia, and have emphasized the marked contrast between the two sets of patients, as a whole.

Essentially their impressions were as follows: The patient's general condition following operation done under anæsthesia by local injections was much nearer the normal state than after ether anæsthesia. There was considerably less nausea and vomiting, his morale was higher, and convalescence was greatly shortened. Further, the family and close friends of the patient were relieved of much anxiety, and there were no long days of waiting while the patient suffered from violent nausea, vomiting, or shock, appearing to the family as if he might die at any minute.

PENETRATING GASTRIC ULCER, SITUATED NEAR THE CARDIA. VISUALIZATION OF THE CARDIA*

By Richard Lewisohn, M.D.
of New York, N. Y.

A man, fifty-four years years old, was admitted to Mount Sinai Hospital in 1922, with a three months' history of epigastric distress without vomiting. Skiagraph showed a large penetration at the lesser curvature of the stomach in close proximity to the cardia. The X-ray department considered this ulcer as carcinomatous, on account of the large size of the crater. (Fig. 1.) Ewald free HCl 30; total acidity 55.

The operation revealed a firm, irregular mass with a large crater situated near the cardia. Many small glands (size of a split pea) were seen on the omentum. One of these was removed for microscopical examination. The gastric mass thought to be carcinoma was considered inoperable on account of its size and position. Closure of abdomen in layers.

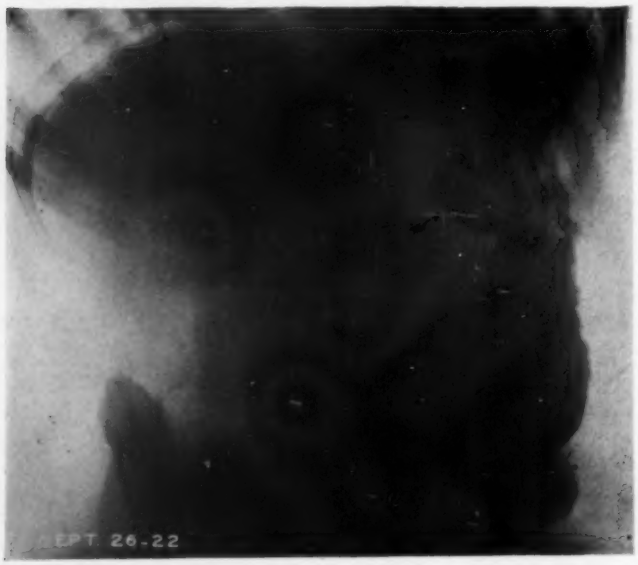

Fig. 1.—1922. Large penetrating gastric ulcers, situated near the cardia.

Microscopical examination of the gland failed to show evidence of carcinoma.

This patient, during the course of three years, was observed in our return clinic. Instead of running the usual course of an inoperable gastric carcinoma, his gastric symptoms gradually disappeared and his general condition improved. X-ray pictures taken in 1923, 1924 and 1925 by Doctor Goldfarb (Figs. 2, 3, and 4) demonstrate a gradual disappearance of the niche. The post-operative course shows conclusively that the diagnosis of carcinoma was erroneous and that we were dealing with a simple ulcer of the stomach.

This patient presented some interesting features both from the medical and surgical point of view. Crohn has shown that some ulcers have a life-cycle. They can grow to large proportions and gradually diminish in size until they practically disappear. In their dormant stage they may represent a small scar. At a later date they may flare up again and re-assume their original size. Patients of this group have been presented repeatedly as cures following medical or surgical treatment. If this patient had been subjected to a Sippy diet or to a gastro-enterostomy, the excellent result would have been ascribed to the therapy, either medical or surgical. The result would have been the

* Paper read and patient presented before the New York Surgical Society, November 25, 1925.

same, not on account but in spite of the treatment. While this patient cannot be definitely considered as permanently cured, his present condition is excellent.

Interest attaches to the X-ray pictures (Figs. 1, 2, 3, 4, 5, and 6) which were made in order to visualize the cardia. The usual gastric plate shows the outline of the stomach, but fails to show the exact location of the cardia. The entrance of the œsophagus into the stomach varies considerably, sometimes the cardia is situated very high, in other cases it enters fairly low down. This variation assumes considerable practical importance, when we are confronted with the question whether an ulcer situated near the cardia is amenable to subtotal gastrectomy.

FIG. 2.—1923. Ulcer markedly diminished in size. Note incisura opposite ulcer.

The visualization of the cardia has interested me for a number of years. I discussed this subject before the New York Surgical Society two years ago, when I demonstrated some plates where the cardia had been visualized by a thin feeding tube in combination with a ureteral X-ray bougie (ANNALS OF SURGERY, 1924, vol. lxxix, p. 143). Later I replaced the bougie by a wire-spiral. The pictures were not clear, as the gagging of the patient prevented a clear outline of the cardia.

Recently I saw quite accidentally some pictures of carcinoma of the cardia taken by Doctor Goldfarb, which demonstrated very clearly the location of the cardia. In these cases a thick mixture of barium was used. After consultation, with Doctor Goldfarb, we decided to combine the two procedures. The patient receives the usual barium mixture in order to outline the stomach and demonstrate the ulcer on the lesser curvature. Immediately before taking the picture the patient swallows the thick mixture. Thus both the ulcer and the location of the cardia are shown on the same plate. While in the plates shown (Figs. 5 and 6) the ulcer was evidently at the place of predilection (reëntrant angle) and therefore did not require a pre-operative demonstration of the cardia, this procedure might have been applied advantageously in the patient now described.

FIG. 3.—1924. Ulcer has practically disappeared. No incisura opposite ulcer.

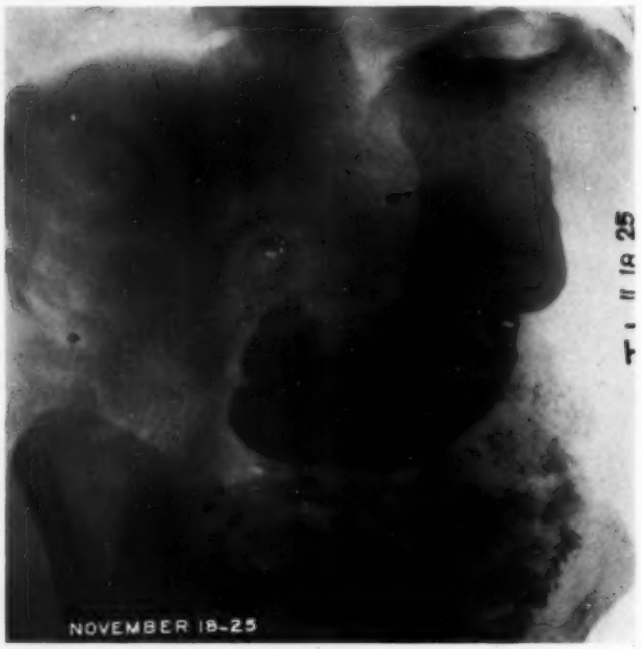

FIG. 4.—1925. Small pin-point elevation on the lesser curvature shows location of former large crater-ulcer.

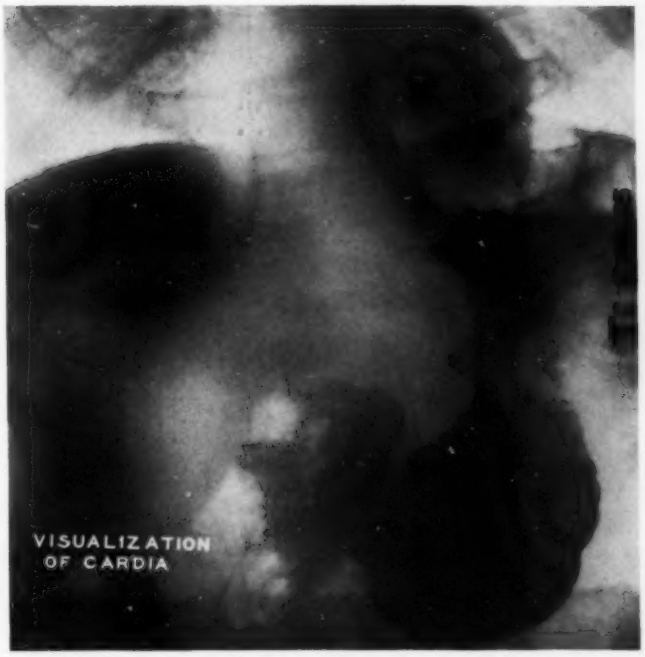

FIG. 5.—Visualization of the cardia. Patient R. K. Penetrating gastric ulcer.

FIG. 6.—Visualization of the cardia. Patient, F. L. Penetrating gastric ulcer.

PEPTIC ULCER OF MECKEL'S DIVERTICULUM

By E. Stulz, M.D.

AND

P. Woringer, M.D.

OF STRASBOURG, FRANCE

FROM THE CLINIQUE CHIRURGICALE A DE LA FACULTÉ DE MÉDECINE DE STRASBOURG,

DIRECTOR: PROF. RENÉ LERICHE

Meckel's diverticulum is often the cause of serious abdominal trouble. Intestinal obstruction and diverticulitis occur rather frequently and are well known. The development of peptic ulcer in a diverticulum would appear not to be generally recognized. We think that this pathologic condition is not so exceptional, since two well individualized cases came to be observed by one of us in the course of three years. Bibliographic researches enabled us to find only twelve cases, but we ask ourselves whether a great number of "diverticulitis perforans" records are not in fact perforated peptic ulcers.

In this paper we purpose to give first a brief outline of our personal cases; that stand for two well-defined types of peptic ulcer of the diverticulum, then to give an outline of the clinical aspect of the disease as founded on the critical study of the records given up to now, and to conclude with the discussion of its diagnosis, pathogeny and treatment.

Case I.—Boy, four years old, without any pathological past, suddenly feels, after having coughed for two or three days, severe pain in the abdomen with vomiting and intestinal hemorrhage. Sanguinolent stools are abundantly evacuated several times in the day. Besides blackish masses there is a discharge of red blood issuing seemingly from the terminal part of the intestine. The practitioner, who sees the child, diagnoses dysenteric enteritis and prescribes dietetic treatment.

Intestinal hemorrhage persists with the same intensity for a whole week. The child grows anæmic, complains sometimes of abdominal pain, but its general condition gives no cause for anxiety. On the seventh day things change suddenly for the worse, temperature, normal up to now, rises to about 39° C., the child complains of severe pain in the abdomen, begins to vomit, passes neither stools nor flatus from the bowel.

We examine the little patient for the first time on the eighth day after the onset of the symptoms; he is very anæmic and exhibits all the signs of generalized peritonitis. His abdomen shows slight distention and défense musculaire, no resistance in the right lower side of the abdomen nor intussusception-tumor is palpated. Rectal examination shows nothing abnormal, the finger is smeared with dark-reddish blood.

Notwithstanding the absence of tumor "en boudin," even under general anæsthesia, we think intestinal intussusception possible, although the profuse hemorrhage preceding by eight days the appearance of peritonitis reminds us at once of the case of perforated peptic ulcer of Meckel's diverticulum seen by one of us with Professor Rohmer[1] three years ago.

On the day of his admission to the pediatric clinic the child is operated upon in order to find the source of hemorrhage and peritonitis. Under ether-anæsthesia the abdomen is opened by a small median sub-umbilical incision; there is some free cloudy fluid, the visible parts of the small intestine are injected and partially covered with fibrinous exudate. They contain no blood.

Whilst looking for the appendix we fall upon a loop of the ileum, slightly distended, whose blackish contents can easily be discerned and are evidently blood. On drawing out this loop there is perceived a Meckel's diverticulum as large as an adult's thumb with a perforation on its base. The intestine situated above the insertion of this diverticulum contains no blood. After drying the peritoneal cavity the eventrated loop bearing the diverticulum is fixed to the parietal peritoneum with some stitches. Ligature of the mesenteric vessels leading to the base of the diverticulum closes the operation.

Inspection of the eventrated intestine shows an elongated, almost fissural perforation, half a centimetre in length, situated on the bifurcation of the intestine and the diverticulum, whose walls are very thickened and indurated at this spot. The aperture gives issue to a bilious fluid, its borders are clean-cut; in its neighborhood the serosa is covered with pseudomembranes.

Forty-eight hours after this minima operation the diverticulum is gangrenous; by snipping it off with the scissors one obtains a wide enterostomy.

For a few days the child has no fever, then signs of peritonitis reappear. Some purulent peritoneal sacs are opened, but, notwithstanding repeated transfusions of maternal blood, the patient grows weaker and dies seventeen days after the operation.

In this case we conclude that there existed a peptic ulcer of the Meckel's diverticulum, situated at the base of the vestige; it had existed for some months at least, as shown by the thickening and induration of the mucosa. This ulcer did not cause any symptom up to the moment when it determined an abundant intestinal hemorrhage lasting more than a week. Seven days after the beginning of the hemorrhage the ulcer perforated into the free peritoneal cavity and produced diffuse peritonitis. The histological study of the diverticulum could not be made in this case.

Our second case came under the observation of one of us with Professor Rohmer [1] in 1922.

Case II.—Boy born prematurely (three weeks), showing normal development at first; at five months passes first red blood from the bowel, has black stools for two days, after which lapse of time everything gets normal again. These hemorrhages are repeated five times up to the age of eleven months, when the child is admitted to the clinic. The parents have the impression that the hemorrhages are accompanied by severe colics.

On first examination in the ward the child seems to be in good general condition but is very pale; his mucous membranes are completely colorless, the skin has a waxen appearance, the extremities are cold, somewhat cyanosed. The blood-count reveals 25 per cent. hæmoglobin, 2,400,000 red cells, normal proportion of white cells. The spleen is not enlarged. Von Pirquet and Wassermann tests are negative.

The abdomen is normal on palpation, shows no tenderness on pressure.

After several days the child begins to vomit and to refuse food. Stools become liquid but do not contain blood. Temperature remains normal with the exception of a solitary rise to 39.5° C. Finally the child gets apathetic and dies in a state of general debility twelve days after being brought to the clinic.

The necropsy reveals the existence of a small Meckel's diverticulum as big as a child's thumb, fixed by a fibrous cord to the peritoneum in the right paravesical region. The diverticulum is incased in a small encysted peritoneal abscess. Adhesions and fibrinous exudates partition it off completely from the general peritoneal cavity which contains no free fluid. On removing these adhesions there issue some drops of a thickish and viscous liquid. On opening the diverticulum one finds at the precise spot where the diverticular mucosa touches the intestinal, a small, deeply excavated ulcer with clean-cut borders. The intestinal and diverticular walls surrounding the ulcer are indurated, show thickening and hyperæmia. The ulcer has burrowed deeply into the subperitoneal tissues. The histological examination could not be made.

This child was affected with an ulcer of Meckel's diverticulum since it was five months old, at which age the first hemorrhage occurred. In the course of six

months six important hemorrhages reduce the child to a state of extreme anæmia. It dies from weakness and infection, unable to resist an encysted peritonitis.

In this case there was perforation, but parietal adhesions kept the peritonitis from generalizing; these adhesions explain why the child could live on for a rather long time after the onset of the symptoms.

Cases Observed Prior to Ours.—The oldest record we have been able to find is that of Zimmermann[3] (Strasbourg) in 1903: boy, five years old, has suddenly abundant intestinal hemorrhages followed by symptoms of peritonitis and ileus; he is operated on the sixth day and peridiverticular abscess is opened. The child dies: diffuse peritonitis. The case, in which every pathological examination is wanting, has been considered by the author as a diverticulitis with perforation, but the fact that hemorrhages preceded the peritoneal symptoms makes us believe that there was a perforated peptic ulcer.

The case of Hilgenreiner[3] (1903) concerns a young man of eighteen who ever since his childhood sometimes, had blood in his stools. At fourteen he had very serious melæna. For the two months preceding the operation he frequently passes blood from the bowel and complains of pain in the right para-umbilical region. At the operation there is found a Meckel's diverticulum adhering to the abdominal wall in the umbilical region. A chronic ulcer stretches far down into the abdominal wall. Patient recovers after operation, consisting in resection of diverticulum. The histological examination, and especially the woodcut illustrating the paper, prove that the case was one of chronic peptic ulcer.

A somewhat similar case is that of Deetz[4] (1908): boy of nine, with diffuse peritonitis following perforation of a diverticulum of the small intestine. The diverticulum was coated with gastric mucosa, but the author cannot positively state that there was in his case perforation of peptic ulcer.

In 1913, Hubschmann[5] published a case very similar to ours; it is the princeps record which allowed for the first time to establish the clinical syndrome of peptic ulcer of the diverticulum. A boy four and a half years old, has consecutively to a slight abdominal traumatism abundant intestinal hemorrhages for four weeks. Operation is made for suddenly manifested diffuse peritonitis. The child dies and the necropsy shows an ulcer of the base of diverticulum perforated into the free peritoneal cavity. Microscopical examination shows a diverticulum entirely coated with gastric mucosa, at whose margin the ulcer was found.

The case of Jackson[6] (1915) concerns a boy ten years old, who had repeated severe intestinal hemorrhages. In the year preceding his admission to the hospital the child had suffered four attacks of excruciating abdominal pain with vomiting, but without melæna. On performing intra-abdominal exploration there is found an indurated and inflamed Meckel's diverticulum, whose suppression by intestinal resection is followed by recovery. At the base of the diverticulum, at the line of union of two mucosæ of different aspect, there is seen a deep ulcer, "in appearance it resembled an indurated duodenal ulcer." The serosa of the diverticulum even shows a star-shaped cicatrix in the spot of the ulcer. A small artery whose lumen is perceived on the border of the ulcer, furnishes the explanation of the hemorrhages. Without any histological examination and evidence Jackson assumes a tuberculous ulcer. We rather believe that his first thought, his comparison of the lesion with a chronic duodenal ulcer, is more correct, and the illustrations of his paper have convinced us of the peptic nature of the ulcer.

Gramen's[7] case (1915) is the only one where there were no hemorrhages. The ten year old child complained during one year of vague abdominal troubles. Suddenly diffuse peritonitis shows and operation reveals a perforated ulcer of Meckel's diverticulum. The histological examination corresponds to Hubschmann's findings: the ulcer was situated on the border of a large area of ectopical gastric mucosa.

Meulengracht[8] (1918) gives the clinical record of a twelve-year-old boy who had melæna for some days after having suffered for weeks from abdominal pain. Two weeks later the child dies from septicæmia consecutive to otitis media. The necropsy shows a

diverticular ulcer about to perforate and placed on the margin of a patch of ectopical gastric mucosa.

In the case of Muller[9] (1919) a child aged eleven is beset by persistent abdominal pain five months after having had melæna. Eight days later there suddenly appears a syndrome of peritonitis. At the operation there is seen a perforated diverticular ulcer. The perforation is sutured and the child recovers. Some weeks later the diverticulum is excised "à froid." Microscopic examination is absolutely identical with Meulengracht's case.

In 1922, Megevaud and Dunant,[10] speaking of a fresh case, give a critical review of some former cases. Their patient, aged twenty-eight, has had since childhood repeating intestinal hemorrhage, the severest of which occurred at the age of four or five. As an adolescent he frequently passed blood from the bowel. The abdominal pain which he complained of was ascribed first to epigastric hernia, then to chronic appendicitis and at last to duodenal ulcer. The cure of the hernia and appendicectomy brought about no change in the state of the patient. Finally the third operation, performed after a new and extremely severe hemorrhage, reveals the existence of an ulcer at the base of a Meckel's diverticulum, bordering on the ileal mucosa. Resection of the diverticulum was followed by recovery. The diverticulum was entirely coated with gastric mucosa.

The case of Brasser[11] (1924) has been published under the heading: Ulcus peptic-um perforans of Meckel's diverticulum. A boy aged fifteen feels during a trip, pain in the lower abdomen. Ten days later there appear intestinal hemorrhages. The hemorrhages repeat and indicate an exploratory laparotomy, which is performed with the provisional diagnosis of tumor or polyp of the colon. The colon is found filled with blood but otherwise normal. Loops of small intestine do not contain blood. The abdo-men is closed, but eight days later there appears diffuse peritonitis which kills the patient within forty-eight hours. Necropsy shows the cause of hemorrhage and peritonitis: there exists a Meckel's diverticulum, as big as a pigeon's egg, with a club-like swelling on its free extremity. On its base, quite near to its insertion on the bowel, one perceives a hole of the diameter of a lentil. No other ulcer is found on the intestine. The histo-logical examination shows that the club-like swelling was coated with typical gastric mucosa. The ulcer is astride on this gastric mucosa and the mucosa coating the remainder of the diverticulum and belonging to the intestinal type. The ulcer has all the microscopical characters of peptic ulcer.

In 1924, there are published the cases of Guibal and of Hallopeau and Humbert. Guibal's[12] patient, fourteen years old, had for six months intestinal hemorrhages occurring with short intervals. The operation shows a chronic and callous ulcer on the borderline of diverticular and intestinal mucosa. The ulcer had scooped out a cavity in the mesenterium of the ileum and opened there some small arteries; excision of the diverticulum was followed by recovery.

Hallopeau and Humbert's[13] record is like our case of 1922, that of a male nursling, eleven months old. The child had suffered, at five and eight months, from abundant intestinal hemorrhage. Three months after the last hemorrhage there is a sudden rise of temperature and the symptoms of diffuse peritonitis appear. Operation, performed on the third day, shows the presence of a Meckel's diverticulum, bearing on its anterior wall, slightly nearer to its free extremity than to its base, a perforation due to an oval ulcer, with clean-cut borders. Histologically a peptic ulcer in the border of a gastric mucosa area. The child dies on the same day.

Whilst the thirteen cases reported occurred mostly in male children, a fourteenth that came to be observed by Pascale[14] of Naples is that of a man aged forty-one. The patient had suffered from several attacks of abdominal pain accompanied by emission of bloody and purulent stools. Operation was performed with the diagnosis of "ulcus simplex" of small intestine; there was found a Meckel's diverticulum with ulcer, whose peptic nature was corroborated by histological examination. Excision of the diverticulum was followed by recovery and suppression of abdominal attacks.

Taking as a basis the clinical records of the fourteen cases hitherto known, one can delineate the syndrome of ulcer of Meckel's diverticulum. Thus Hallopeau and Humbert studying its symptomatology have already laid stress on the fact that "clinically, hemorrhage and perforation are the essential symptoms of this disease." Nevertheless we ought to remember that the records published up to now belong to severe cases with a strikingly well-defined symptomatology. Possibly future cases will show that diverticular ulcer does not always belong to a type redundant with serious symptoms and that it may, as well as gastric and duodenal ulcer, exist without very definite and striking symptoms, or that it even may exist without any signs at all for quite a long time. Therefore we lay stress on the fact, that whilst giving here the clinical description of diverticular ulcer according to the published cases, we only describe its severe type with concomitating complications, such as forces itself on the patient and his family with its dramatic features and calls for immediate surgical aid on account of its serious prognosis.

Diverticular ulcer is a disease of childhood and appears at a time of life when gastric ulcer is practically non-existent. Two of the cases known up to now are those of nurslings who evidenced the first hemorrhage at five months, four children at an age from four to five years, seven from nine to fifteen.

It is interesting to note that all these cases appeared in male children.

The first and at the same time the most constant sign is abundant intestinal hemorrhage: Gramen's case is the only one where this sign was missed. As a rule the child begins to pass blood in full health, in some cases after having complained for some time of abdominal pain; it emits several times a day stools that are almost exclusively composed of blood of blackish or (and that must be carefully noted) reddish aspect, that is not modified by the digestive process. The amount of emitted blood is difficult to evaluate, but seems to vary from some tens to some hundreds of c.cm. Anyhow there never is emission of sanguinolent mucus as seen in intussusception or dysentery, but genuine melæna.

The intestinal hemorrhage may last for some days or even for some weeks and produce in the patient a state of marked and even lethal anæmia. If the child keeps alive and if there is no perforation, the hemorrhage stops after a lapse of time, but only to start afresh after some weeks or months. This tendency to repetition constitutes together with the abundancy and the red color of the blood emitted one of the main characters or hemorrhage in diverticular ulcer.

Perforation is after hemorrhage the symptom complicating most frequently the clinical picture. It has been reported in ten out of fourteen cases; seven times it occurred into the free peritoneal cavity, three times into the neighboring tissues (abdominal wall, mesenterium) with consecutive formation of adhesions and encysted abscesses. The perforation may occur during the hemorrhagic phase as in one of our cases (eight days after the onset of the melæna) or even some months after the last hemorrhage noted. In some

cases abdominal pain that could not be accurately localized appeared some days or some weeks before the symptoms of peritonitis.

Palpation of the abdomen does not, as a rule, give a clue to diagnosis. In most cases the abdomen has been without defense and without any well-localized tenderness. In Hilgenreiner's case, where the diverticulum adhered to the abdominal wall, a para-umbilical tumor had been perceived before the operation.

The pain noted in several cases has no special features. It may be permanently diffuse or as in our case simulate colics. Hilgenreiner's patient, aged eighteen, complained of pain in the right para-umbilical region.

The clinical evolution of the disease can be long when the hemorrhage from the ulcer is well tolerated and when, by the formation of adhesions, perforation into the free peritoneum is made impossible. This must have been the case with Megevaud and Dunant's patient who was operated upon at the age of twenty-eight and had shown the first symptoms of the disease at four or five.

The marked tendency of diverticular ulcer towards perforation makes the *prognosis* particularly severe, if we may judge from the cases recorded. Of fourteen patients, seven died, six of those from diffuse peritonitis. Meulengracht's patient died from intercurring infection. Only six patients could be saved by the operation; all of them were over ten at the time of operation.

Diverticular ulcer in children has so very marked a tendency towards perforation that one must always be in fear of it even when, after a first hemorrhage recovery has seemingly resulted. In Muller's case peritonitis suddenly appeared five months after a single melæna. Operation must be done immediately after the first symptoms have been noted.

Intestinal hemorrhage being, in the present state of our knowledge, the main symptom allowing to suspect a non-perforated diverticular ulcer, the *differential diagnosis* must be made with intussusception. When an infant suddenly passes blood from the bowel, one will suspect in the first place intussusception, which is of far more frequent observation than diverticular ulcer. But there are some signs that allow differentiation. Vomiting and colic-like pain are much more marked in intussusception. In intussusception blood is as a rule passed in small quantities and is intimately mixed with mucus, whilst blood is very abundant and in state of purity, partly black, partly red in the hemorrhage from diverticular ulcer. Once only have we met with an abundant hemorrhage, absolutely similar to that of diverticular ulcer in a case of intussusception of the small intestine that had been occasioned by a diverticulum Meckeli.

The presence of a tumor "en boudin" perceived on palpation is in favor of intussusception, but one knows that this sign is often missed in the course and especially at the beginning of this disease.

Peritonitis is of frequent occurrence in both diseases. Abundance of

blood and absence of pus and mucus enable us to distinguish between diverticular ulcer and dysentery or infectious entero-colitis.

Differential diagnosis with a bleeding polyp or tumor of the colon can be difficult and even, in some cases, be made only during operation.

Lastly, melæna neonatorum cannot be mistaken for diverticular ulcer if one bears in mind that melæna is a disease of the first days of extra-uterine life, whilst diverticular ulcer does not appear before the child is some months old.

The main point in the *pathology* of ulcer of Meckel's diverticulum is the constant presence in the affected diverticula of more or less extensive areas of gastric mucosa with pyloric glands, Brunner's and fundus glands. It is well known that heteroplasia of gastric mucosa in Meckel's diverticulum is not exceptional (occurring as it does in about 12 per cent. of cases). They must no longer be considered as mere anomalies of development since they may have a very great pathological significance. Every diverticular ulcer, that has been subjected to histological examination, had developed on the margin of the gastric mucosa area, on the borderline of the mucosa of intestinal type whether still intradiverticular or already ileal at its insertion on the intestine. The histological picture of the ulcer is that of gastric or duodenal ulcer, or better still, that of peptic ulcer of jejunum following gastro-enterostomy (Hubschmann). Its terebrating tendency is shown not only by the fact of its sometimes reaching quickly the diverticular serosa and perforating but also by its hollowing out a " niche " in the mesenterium or the abdominal wall, according to its seat and its adhesions. From this point of view there is a perfect analogy with duodenal and jejunal ulcer. This analogy might be traced further, one might for instance establish a distinction between the chronic and callous and the acute type. It is enough to say that Meckel's diverticulum, whether with a total or only a partial coating of gastric mucosa, can and does behave like a miniature stomach (Guibal). The general outline of its pathology is that of gastroduodenal pathology.

This brings us to the discussion of the pathogeny of diverticular ulcer. Diverticular ulcer is a peptic ulcer, it develops at the union line of two mucous membranes one of which, of gastric type, possesses an acid secretion that can corrode the epithelium of the other, of intestinal type, accustomed only to perfectly alkaline juices. After all, this explanation does not solve the pathogenic problem because all diverticula with heteroplasia of gastric mucosa certainly contain acid secretions (Lexer,[16] Tillmanns [17]), but do not therefore necessarily have there peptic ulcer. We fully believe that records like those we have given, are entitled to a prominent consideration in further study of the origin of peptic ulcer generally speaking. We do not intend to open the discussion here.

One must conclude from this chapter that the diverticular ulcer is a peptic ulcer mostly of acute evolution opening vessels penetrating into neighboring organs and making its way towards the free peritoneum; it then perforates and provokes diffuse or limited peritonitis. The ulcer of the diverticulum

has nothing to do with "diverticulitis"; the latter stands in the same relation to the diverticulum as appendicitis to the cæcal appendix. Certainly perforating diverticulitis has more than once been mistaken for perforated diverticular ulcer, before Hubschmann's fundamental report and even afterwards.

Treatment of peptic ulcer of Meckel's diverticulum may have to be undertaken under three circumstances:

I. The ulcus is diagnosed "à froid," that is to say, without there being hemorrhage or perforation at the time.

The only logical therapeutic measure is then surgical removal of the diverticulum with the ulcer. It suppresses every possibility of ulterior accidents.

II. One has to deal with a profuse intestinal hemorrhage exhibiting the characters described above: it is then likely that it is due to a diverticular ulcer, without one being absolutely certain that it does not come from a tumor or a polyp of the colon.

Here also—contrarily to the usual treatment of hemorrhages from gastroduodenal ulcers—instantaneous surgical action is necessary. We say instantaneous because once a diverticular ulcer has begun to bleed it often perforates very quickly and quite unexpectedly. It is better to operate a child even markedly anæmic than to run the risk of being obliged to act under much more severe conditions when the peritoneum is already flooded with highly septic matter.

A small subumbilical median laparotomy will quickly show the seat of the hemorrhage. It is easy to make out whether the colon and the last ileal loops contain blood, whereas the higher ones do not show any. One does not encounter here the difficulties one has to overcome in order to find a small hemorrhagic ulcer of the stomach or the duodenum. Diverticular ulcer can only bleed inside a tiny organ which can in most cases be easily excised in toto. By taking out the diverticulum one is certain to have stopped the hemorrhage and prevented all other complications.

The results of radical interventions during the period of hemorrhage—still few in number—show that this active treatment is well founded. The cures obtained by Guibal and by Dunant are absolutely demonstrative from this point of view. One will usefully fight the anæmia and operative shock by blood transfusion.

III. One is called when the ulcer has already perforated into the peritoneal cavity. If the symptoms of peritonitis have not been preceded by the typical intestinal hemorrhage, the diagnosis will be in most cases that of perforated appendicitis because the first signs appear on the right of the abdomen. A tendency to wait under these conditions—faulty as well in appendicitis—would lead to unfortunate consequences.

Peritonitis by perforation of diverticular ulcer holds a more serious general prognosis than perforated gastric ulcer. This is due to the fact that it affects almost always children and that the fluids invading the peritoneal cavity, coming from the inferior extremity of the small intestine, are, except

perhaps in the nursling, considerably septic. One should not hesitate a moment to undertake the surgical act that alone can save the patient.

What shall be the operation? A minimum intervention or removal? Resection seems only indicated in cases when one is, as who should say, eye-witness of the perforation. Consequently the indication will be exceptional. If peritonitis has already had time to extend—and a few hours are enough for this—one must be satisfied with a minimum action. Obturation of the hole and cleansing the peritoneum will then be the main indications. The radical operation will be performed after all peritoneal complications have disappeared. Muller cured his little patient by proceeding this way. Another method of rapidly suppressing the source of peritoneal infection would be to act as we did: exteriorise the loop with the perforated diverticulum according to well-known principles. It allows, moreover, to ligate without any danger the mesenteric vessels whose branches may only be imperfectly thrombosed at the level of the ulcer. The enterostomy which forms spontaneously after the fall or the removal of the diverticulum may certainly be useful in the treatment of the peritonitis. Its disadvantage is the secondary operation of closure which may be necessitated and which sometimes is the equivalent of an intestinal resection.

Therefore the treatment of peptic ulcer of Meckel's diverticulum is essentially surgical. It is to be hoped that on the gradual spreading of the knowledge of this interesting disease amongst physicians and surgeons, its diagnosis will be made more often and in earlier phases. The treatment shall then without any doubt be more efficacious.

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DILATATION OF THE COMMON BILE DUCT IN THE ABSENCE OF FUNCTIONING GALL-BLADDER*

By Robert C. Coffey, M.D.
of Portland, Ore.

In the course of experimental work for the study of the mechanism of duct delivery of the secretions of an organ into a reservoir or a functioning hollow organ, it has been found that there is something far more important in the transplantation of the delivery end of a duct from one organ or location in the body into a new organ or new location than the mere technic of the performance. Fundamental questions are involved. The technic of the operation by which the transplantation is done bears the same relation to the transplantation, in its entire significance, as the artisan's work bears to the construction of a great building, a bridge or a railroad. It is necessary to study such abstract fundamental principles as the general transmission of matter by force or power against gravity or other forces; the transmission of matter by force or power against gravity or other forces by specific measures, such as through a confined passageway or tube; more specifically the transmission of fluids and gases of the body against static intra-visceral or intra-vascular pressure; the principle of valve action; the structure and relative function of valves and sphincters, etc.

Most of the great motive forces of Nature travel in waves. Biological activity is usually intermittent. The plant rests in winter. The animal sleeps while force is regenerated. The overloaded, stalled locomotive rests while the fires burn and more steam is generated. The man carrying a heavy load up a hill temporarily lays down his burden while the fires of his body create new energy. A teamster hauling heavy loads up a long steep hill, in a wagon which has no brakes, has a block of wood attached to one side of the wagon so that it drags passively behind one of the rear wheels. When the team stops to rest, the wagon recedes a few inches and the wheel rests against the block, so that no ground will be lost and all the new energy of the team which has accumulated during the rest period will be utilized in the forward movement of the load without reduplication of effort. The block automatically stops the wagon without any effort or animation and is passively in place when needed again.

A power pump located ten feet above a river lifts water through an enclosed pipe to a height of 100 feet against gravity. The force lifting the water is applied intermittently. During the intermission an inanimate piece of metal automatically slips under or behind the load and holds it until another application of the propelling force. This piece of metal is called a valve. When the propelling force is applied to the piston which lifts the column of water, a vacuum is formed in the wake of the piston. The valve

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opens toward the area of lesser pressure followed by an inrush of water from the river. If the motive power ceases, the weight of the water in the pipe closes the valve and holds it. The pressure which holds the valve closed during inaction may be called static pressure. The heart, an animated, innervated, muscular organ, propels the blood through an elastic tube against a resistance amounting to a certain number of millimetres of mercury. Its efforts are intermittent. During intervals of activity, the heart rests like the team. While it rests, the force against which its activities are directed rebounds and automatically spreads out three small inanimate, non-motile, membranous folds which block the opening and prevent further recession. In other words, they hold the load while the heart rests. These membranous folds are called valves. The pressure holding the valves closed during the rest period is known as diastolic pressure or may be called static intra-vascular pressure.

Stedman has given an anatomical definition of valve as " Any membrane or duplicature of a membrane which prevents a reflux in the vessels and canals of the body." I think a more specific definition would be the following: A valve is a non-motile, inanimate, movable gate or obstruction, placed at the threshold or in the course of a vessel or tube, which automatically acts to prevent a reflux of matter from an area of greater into one of lesser pressure.

A sphincter is a motile, innervated gate or obstruction placed at the threshold or in the course of a cavity or canal, for the purpose of retarding the onward or outward flow for the convenience of the biological or animal mechanism.

A valve is equally active in an animate and an inanimate mechanism. A sphincter is effective only when animated or innervated. In the animal mechanism, a valve is used where the activities of vital organs are to be certainly protected. A sphincter is for the purpose of improving function. The true valves of the body, such as those which protect the outlet of the ureter into the bladder, of the bile duct into the duodenum, of the heart into the aorta, function just as well after the patient is dead as during life. A sphincter ceases to function during paralysis or at death.

A study of the outlet of the ducts carrying the secretions of the liver and the kidneys reveals the fact that the terminal portion of these ducts run under a loose, non-animated fold of membrane before entering the lumen of the viscus where intra-visceral pressure is greater than that of the secreting organ and its ducts.

In the Jubilee number of the ANNALS OF SURGERY, issued December, 1909, was published a paper of mine with the title, " Pancreato-enterostomy and Pancreatectomy." This paper was a report of six months' experimental work conducted with the view of studying principles and developing a method of dealing with an obstructive lesion in the head of the pancreas. Two plans were used. In one the tail of the pancreas was cut off and implanted into a specially constructed loop of bowel after first obstructing the normal delivery ducts. This was accomplished and the duct delivered its secretion back into the intestine without injury to the pancreas. The other plan was to remove

the head of the pancreas and implant the cut end of the pancreas into a similar loop. For chronological accuracy in the development of this subject, I will quote that part of the wording in this article which bears on our present subject:

"Pancreatectomy was done in two stages as follows: First operation.—The common bile duct was transplanted into the duodenum lower down, gastro-jejunostomy was performed and the stomach was cut off and ends turned in just above pylorus. Second operation, or second stage of operation: The body and duodenal tail of the pancreas and

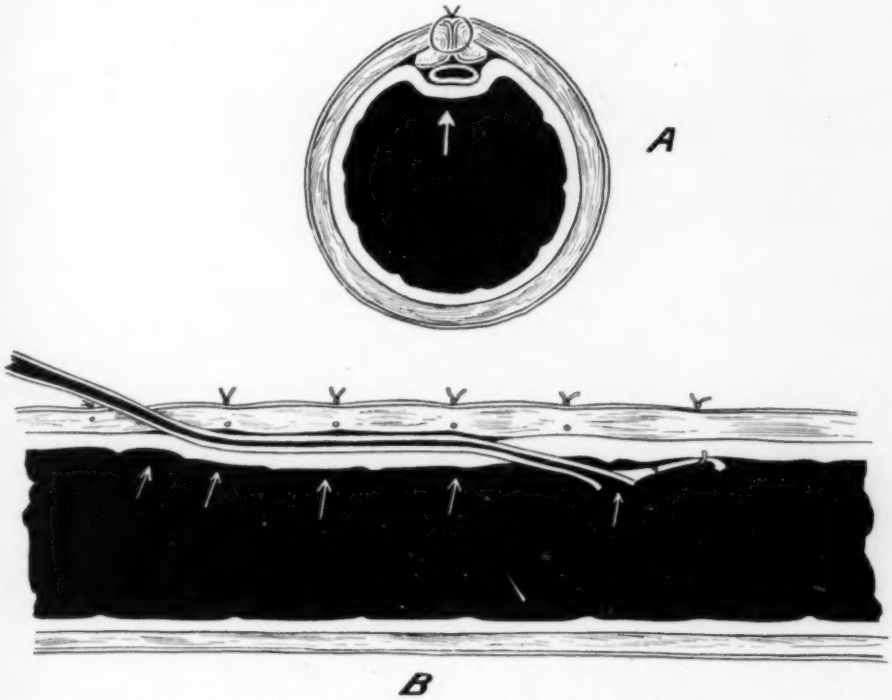

FIG. 1.—Sectional view (diagrammatic) illustrating the relation of the bile duct to the coats of the intestine after physiological implantation of the bile duct. (Arrows indicate the direction of intra-intestinal pressure.) A, cross-section. B, longitudinal section. ANNALS OF SURGERY, December, 1909.

the duodenum were removed and the retrogastric tail of pancreas was planted into a loop of jejunum.

"The common bile duct which had been transplanted at the first operation was as large as a man's finger, while the mouth would admit a lead pencil. The hepatic ducts were distended in the same way well up to the liver. Five other dogs with the same operation showed the same condition of bile ducts."

The seventh conclusion after the first series of experiments was: "A bile duct which has been transplanted by the direct method, becomes widely dilated and at the same time thickened by intra-intestinal pressure of some kind, which may have a very important bearing on this subject." This brought up a new problem which was dealt with in the manner described in the following words:

"Our next defect was in our method of implanting the bile duct. By studying the bile duct of the dog, it was observed to run under the mucous membrane of the duodenum for almost one inch before it opened out into the canal. It was at once seen that this arrangement effectually prevented the intra-intestinal pressure from being brought to bear from within the duct, owing to the fact that it was brought to bear along the course

of the duct through the mucous membrane, thus effectually making a valve. The problem then was to duplicate this condition as near as possible. The first thought was to split apart the layers of the intestine with forceps and drag the duct through. This was a cumbersome method until we were reminded of the protrusion of the mucous membrane which occurs after the outer coats of the stomach and intestine have been cut through

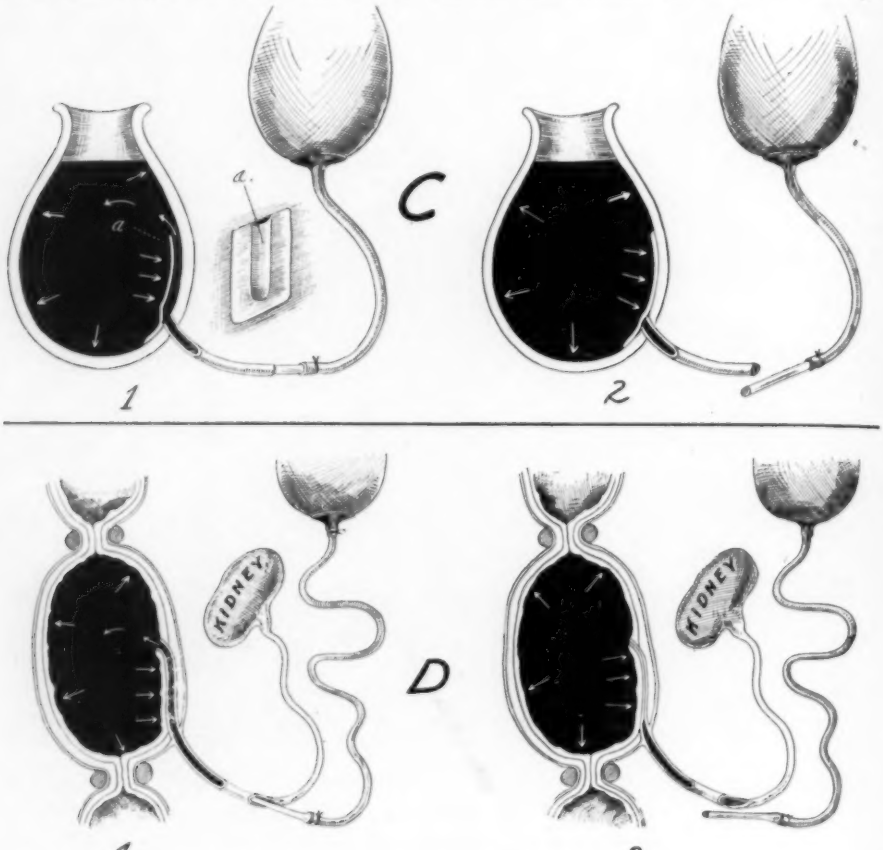

FIG. 2.—C, Partial artificial lining of a rubber bag with a thin piece of rubber cemented on the inside. 1. The fluid is running into the bag notwithstanding the pressure indicated by the arrow because the height of the fountain syringe produces greater pressure than exists in the bag. 2. When the greater pressure from the fountain syringe is removed, the intravesical pressure collapses the inside lining.

D, Segment of intestine into which the ureter was implanted 169 days prior to removal of specimen. 1, Running fluid into segment of intestine under pressure. (A counterpart of experiment made on rubber bag, Fig. 2 C.) 2. Shows pressure of fountain syringe released by withdrawal of nozzle. The pressure within the intestine immediately closes the valve by pressure of the mucous membrane. Not a drop could be forced back into the duct. (An exact drawing of the valve in the same specimen is shown in Figure 4, compared with the valve in a normal dog's bladder, Figure 3.)

during the operation of gastro-enterostomy. The following operation was, therefore, devised for implanting the bile duct:

"First, the duct is located and ligated with linen or silk near its point of entrance into the duodenum. It is then cut in two and the edges caught and held with mosquito forceps while one wall of the duct is split down with a pair of scissors. A linen suture is now passed through the split end of the duct so as to include about half of it, and tied. The linen thread is then thrown around the other half, and tied. The loose end is then threaded into another needle. By this method, the full strength of the duct is then retained for traction while the opening is maintained by the split. The end of the duct is now wrapped in gauze while the intestine is prepared for its reception, which

is done as follows: Pick up the part of the intestine desired and cut down through the peritoneal and muscular coats, including the submucous tissue until the mucous membrane pouts out through the incision. This incision should be about one inch long. Second, pass five sutures which pick up the peritoneal and muscular coats on each side of the incision. Tie the suture at the upper end of the incision. Lift up the three intermediate intestinal sutures on the flat handle of an instrument, as they cross the incision. Make a small stab wound in the mucous membrane near the lower end of the incision. Now bring the intestine close down to the end of the split duct and pass the two needles carrying the threads on the end of the duct, beneath the three intestinal sutures and into the intestinal lumen through the stab wound in the mucous membrane, and out through

FIG. 3.—The valve in a normal dog's bladder is lifted on the end of a probe.

the intestinal wall one-half to three-quarters of an inch further along the intestine and one-eighth to one-quarter inch apart. By making tension on these threads and at the same time pushing the intestine toward the duct, the bile duct is drawn beneath the intestinal sutures and into the intestinal lumen, through the stab wound, when the two ends of the threads on the duct are tied on the outside, thus anchoring the end of the duct on the inside of the intestine at this point. The intestinal sutures are then tied. After this operation the duct lies just beneath the mucous membrane, which has been loosened for approximately three-quarters of an inch of its course, so that the intra-intestinal pressure is brought to bear on the duct along this entire distance, thus counteracting the intra-intestinal pressure which in the direct implantation is brought to bear in the inside of the duct." (Fig. 1 A and B.)

Immediately after the meeting in December, 1909, I began another series of experiments on the bile duct and on the ureters, using the same principles. The results were reported and specimens exhibited to the Surgical Section of the American Medical Association at St. Louis, in June, 1910, under the

title "Physiologic Implantation of the Severed Ureter or Common Bile-duct into the Intestine." Illustrations for the technic adapted to the implantation of the ureters were submitted and published with the report in the *Journal of American Medical Association,* vol. lvi, February 11, 1911.

The results of experiments were published in this article as follows:

"In five dogs with direct implantation of the bile duct, all specimens showed marked dilatation; of the four dogs in whom the duct was transplanted by the submucous method, none showed dilatation of the duct. Of six dogs in whom direct implantation of the ureter was performed, five died with pyonephrosis as a result of the operation, while

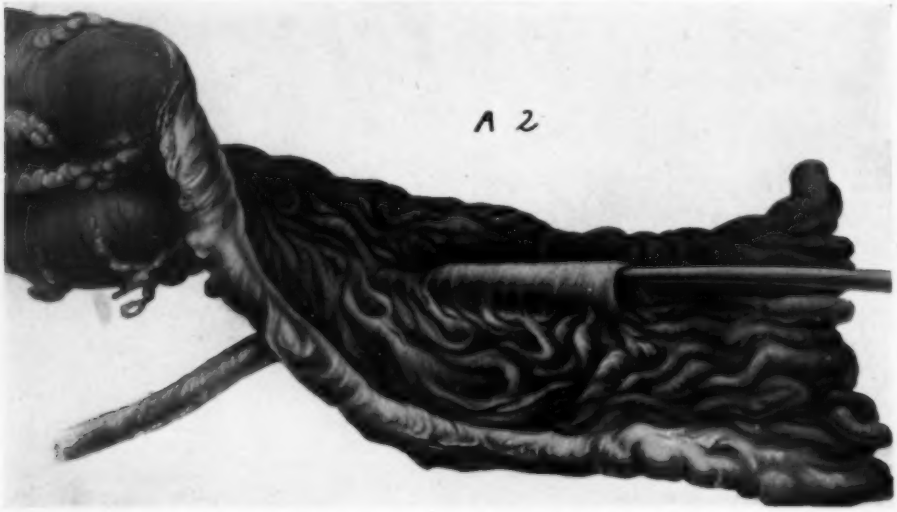

FIG. 4.—The valve in a dog's intestine following submucous implantation. Specimen removed 167 days after implantation. Compare with valve in dog's bladder, Fig. 3.

the sixth lived and was killed sixty-one days after operation when it was found that the kidney with implanted ureter had been totally destroyed, leaving only a shell of fibrous tissue while the ureter was dilated and remained wide open. Thus, every ureter and every bile duct which was transplanted directly into the intestine without valve formation dilated throughout its extent, including its opening into the intestinal lumen. On the other hand, of nine dogs whose ureters had been implanted by the submucous method, four had died operative deaths from general complications such as may be encountered in any form of complicated abdominal surgery. The five who recovered from the immediate effects of the operations showed undamaged kidneys and undilated ureters when the dogs were killed at periods ranging from 60 to 167 days after operation. Removed specimens when tested showed that the valve action was perfect mechanically in the dead intestine as well as in the living. In Fig. 2-d is shown a post-mortem experiment which was made in all these cases. So perfect was this valve in one instance that by using my entire weight and stepping on the obstructed intestine, rupture of the bowel occurred without causing a reflux of the fluid through the ureter which had been injected. All the other specimens in this series showed similar valve production. Figures 3 and 4 show the similarity of the valve which has been surgically constructed in the course of the submucous implantation of the ureter to the normal valve in a dog's bladder."

It may, therefore, be said: (1) When a duct is implanted into the intestine directly without valve formation, the duct always dilates. (2) When valve formation is produced the ducts do not dilate. (3) Valve formation is pro-

duced by running the duct under the loose, non-motile, unanimated mucous membrane for a distance before the duct emerges into the intestinal lumen. This valve forming operation has been proved efficient clinically in nearly a hundred operations by C. H. Mayo and twenty-eight by Dr. W. E. Lower, and some fourteen by myself, and a considerable number by Drs. Frank Hinmann, Hunner, Bartlett and others, making a total of almost two hundred of which I have heard.

It is an interesting fact that Dr. Franklin H. Martin, in 1898, devised a method of implantation of the ureters into the bowel which on casual observation very closely resembles this submucous implantation above described, but when his own statement concerning the purpose of the technic is studied, it is found that the resemblance is not so close as it appears, for instead of cutting through the muscle of the intestinal wall and burying it so as to get the valve action of the collapsible mucous membrane, he carefully exposed the muscle of the intestinal wall without cutting it and wrapped it around the lower end of the ureters, so to speak, with the evident purpose of producing a sphincter instead of a valve. He failed only by the thickness of the muscular coat of the intestine. It is conceivable that in the one dog who survived in Doctor Martin's series, the cut might by accident have extended through this thin muscular coat. As has been stated in the differentiation between a sphincter and a valve, a sphincter is used to regulate outward or onward flow and is under the control and caprices of the nervous system while a valve is a non-animated structure and works just as well on an inanimate subject as a live patient and is, therefore, always sure to act in response to the force it is intended to resist. The valve is the only automatic mechanism used in nature by which the secretion of a vital organ with low intra-visceral pressure is regularly delivered into another organ or reservoir of higher intra-visceral pressure.

The pressure in the gall-tracts is much less than the static pressure in the intestine where the gall-duct empties. I am sure many a surgeon is familiar with the phenomenon of an obstructed sigmoid, an enormously distended cæcum, and an undistended small intestine in the same abdomen. This small intestine with low intra-visceral pressure still delivers its contents into the distended cæcum where the static pressure is much greater. This phenomenon is only possible in the presence of a perfectly acting ileo-cæcal valve, as shown by the fact that when the ileo-cæcal valve is short-circuited by an ileo-sigmoidostomy, the ileum dilates synchronously with the large intestine and its intra-visceral pressure becomes the same. The mechanism here is the same as that of the bile under low pressure in the gall-tracts being delivered into the duodenum where the static pressure is much higher. Through the duodenum food is propelled by rhythmic contraction of the muscular wall ordinarily referred to as peristalsis. In the absence of this propelling force, food would remain stationary, the intestine would become filled with gas under a steady pressure which we may speak of as static intra-intestinal pressure. This pressure would hold the valve closed against the lesser

pressure in the gall-tracts until such time as the gall-tract pressure became equal to the static pressure in the duodenum. When peristalsis is active, a propelling wave drives the contents of the duodenum forward. In the wake of this peristaltic wave, a diminished pressure or relative vacuum is produced. During this release of pressure, the bile under low pressure may now move forward into the intestine, even without any propulsion from the upper stretches of the gall-tracts. When the peristaltic wave is spent, the intestine fills out and its contents assume a normal intra-intestinal pressure which, while it is stationary, may be called static intra-intestinal pressure. This pressure closes the valve at the mouth of the duct. When another peristaltic wave passes along the intestine, another vacuum follows in its wake with another emptying of bile into the area of reduced pressure, etc. What proof have we that this takes place? Every surgeon has noted in his practice that a biliary fistula following gall-bladder drainage or duct drainage discharges at night for several days after it has ceased to discharge in day-time. Kehr observed that if these patients were fed at regular intervals during the night, the flow of bile was no greater at night than in day-time. In other words, this flow was not a question of night or day, but was a question of the period of digestion. We have now come to a definite knowledge as to the purpose of the gall-bladder. Mann and others have shown that bile which has been retained in the gall-bladder for some time may be concentrated to ten times that of freshly secreted bile. He has also determined that it is difficult to produce jaundice in a dog even by ligation of the common duct if the gall-bladder is functioning normally. On the other hand, jaundice deepens rapidly after the gall-bladder has been removed. Therefore, the definite function of the gall-bladder as a reservoir and concentrator has seemingly been established. During the hours when active digestion is taking place, it is safe to assume that active peristaltic waves are passing along the duodenum. In the wake of each of these waves, an area of diminished pressure is formed. Into this area of diminished pressure, the bile, which itself is under low pressure, may be delivered. With the cessation of the peristaltic wave, normal intra-intestinal pressure is reëstablished and the valve is closed. The greater the number and strength of peristaltic waves, the more frequent the opportunity for the delivery of bile under low pressure into the intestine. In the absence of food in the stomach and duodenum, peristaltic waves are diminished in number and strength. Normal intra-intestinal pressure is more or less constant. In the presence of the normal intra-intestinal pressure, without the periodic relaxation in the wake of the peristaltic waves, the valve of the gall-duct is held closed by the intra-intestinal pressure until the pressure in the gall-tracts is equal to the intestinal pressure. If there is a drainage tube in the gall-bladder or in the duct, the bile pours out through the drainage tube. If there is no drainage and the gall-bladder is normal, bile is poured into the gall-bladder and is thickened up by the absorption of the watery content and stored for later use. Therefore, the period during which the gall-bladder is called upon to function as a reservoir is during the time when no digestion

is going on. If the gall-bladder has been removed, there is no reservoir. Therefore, during these intervals between periods of digestive activity when there are few peristaltic waves, and the intestinal contents are quiescent, the normal static pressure existing in the intestine holds the valve closed and produces exactly the same pressure in the ducts. The result is that the ducts dilate from the static intra-intestinal pressure, the bile having no gall-bladder into which it can go. These dilated ducts occur when the gall-bladder is filled with stones or pus, when the wall is thickened and has lost its elasticity, when its walls are contracted, and after the gall-bladder has been removed. In short, the common duct dilates in the absence of a functioning gall-bladder. Judd and Mann have claimed that the action of the sphincter of Oddi is important in this connection. Our experiments of transplantation of ducts into the intestine show that when a valve is not produced by the operation, the duct always dilates. When a true valve is produced, it does not dilate. This independent of any sphincter whatsoever.

IS SUCH DILATATION HARMLESS?

It must be conceded that in the great majority of cases, dilatation of the duct gives no very remarkable clinical symptoms, yet we know that in a few cases new stones form in such ducts. In many more of these cases the patients are not entirely well. Occasionally we are called upon to operate upon a patient because of the symptoms. During the year 1924, I operated upon two such cases.

CASE I.—The first patient was operated upon September 13, 1924. I had operated upon her previously on February 17, 1923, at which time I found a gall-stone impacted in the cystic duct. The gall-bladder was filled with mucus. The common duct had several stones in it and the fluid in the common duct was mucopurulent with but a slight tinge of bile. The duct at this time was slightly dilated, the stones moved up and down with ease. The gall-bladder was removed and drainage tube placed in the common duct, after all the stones had been carefully removed and a good opening into the duodenum was assured. Stenographic report taken as operation proceeded.

The patient again comes to operation with the following history since the first operation. From time to time she has had slight fever, distress in the neighborhood of the gall-bladder a great deal of the time and at times has been slightly yellowish, although I think she has not shown real jaundice. She has been in the hospital much of the time recently. All the time we were certain that all the stones had been removed. We also knew that we had an infection in the bile duct which probably was not completely removed. She was finally turned over to my associate, Doctor Sears, who treated her medically. He now advises a second operation with the belief that there must be something either in the way of infection or stone in the common duct. She has not had the chills and fever that common duct stones usually show, but she is not well and we are going to open the abdomen again.

We note the enormous common duct. It is at least three-fourths inch in diameter and is thickened, but by careful examination I can detect no stone. I take a large hypodermic needle and insert it into the duct and withdraw pure yellow bile. No evidence of infection or trouble of any kind showing so far. I pass two traction loops through the wall of the duct and between the loops make a longitudinal incision into the duct sufficiently large to admit my index finger easily. In passing the finger upward I

detect the bifurcation of the hepatic duct. No evidence of a stone or trouble of any kind. It is possible that there is a stone down in the ampulla of Vater. The duct is large enough so that I easily pass my finger downward. No stone is encountered. The index finger passes easily into the duodenum. The mucous membrane forms a rather tight stricture about my index finger which passes well into the duodenum. The head of the pancreas is not materially hardened. We have here a greatly dilated common duct, no evidence of infection, no evidence of stones, no organic obstruction, and yet the patient is having serious trouble. We have a duct almost as large as a duodenum, with an opening that is half as large as the duodenum itself. I can see no good purpose that drainage can accomplish in this case. I therefore close the duct by sutures and place a very small drain down in the neighborhood. Nothing has been accomplished by the operation except the discovery of this enormously distended duct, which in reality is a diverticulum of the duodenum.

Case II.—November 2, 1924. This patient, a man sixty-three years of age, was registered on October 2, 1924, with the following history: In 1905, he was operated upon for gall-stones by a very good surgeon, after having had frequent attacks of gall-stone colic, with a pain also occurring under the left rib arch. A small gall-bladder containing stones was removed at the time and a small rubber tube drain was used. The patient was not entirely relieved of the left-sided pain.

For three years just past he has periodically had sharp, increasingly severe attacks of pain in the left upper abdomen, exactly similar to the pain which he had before the gall-bladder was removed nineteen years ago. Recently he has had more frequent attacks, and for the past three weeks has been almost constantly ill. He has had a feeling that the pain has something to do with meals but his physician, an internist of note, finds there is bile in the urine after each of these attacks of pain. The internist is of the opinion that there is probably an obstruction in the common duct, possibly gall-stones.

In our examination we have found there is definite gastric hyperacidity. Patient has been under observation for a month, during which time he has had other attacks of pain in the left side of the upper abdomen. Bile has each time been discovered in the urine, along with a gradually increasing jaundice in the skin and sclera of the eyes. Having had the experience of a case with a similar history recently, we come to operation with the pre-operative diagnosis, "Dilated common duct with possible pancreatitis."

Observations during operation: The stomach is firmly adherent to the under surface of the liver in the bed, from which the gall-bladder had been removed at previous operation and cannot be separated without dissection. Dissection is made with difficulty. After mobilizing the duodenum and stomach from the bed of adhesions, the common duct is found. It is three-fourths inch in diameter, its wall practically as thick as shoe leather, yellowish-white in color, with a few blood-vessels running across it. A hypodermic needle introduced into the duct shows pure yellow bile, no stones.

Two traction loops are placed in the wall of the duct toward the liver end, a long incision is made in the middle of the duct between the two loops. The gloved index finger passes easily to the bifurcation of the hepatic duct. No stone found. There is ample room for easy passage of the finger. The index finger is now turned downward and passes easily into the duodenum. The last joint of the index finger passes through the channel in the head of the pancreas rather tightly and through the ring of mucous membrane which makes mild constriction on the finger. A large prostatic sound No. 26 passes easily into the duodenum. Two inches beyond the pancreas the point of the sound is made to show pressure through the wall of duodenum. Bile in the duodenum is yellow and pure, showing no evidence of inflammation or pus.

The liver is adherent to abdominal wall but normal in every way. Head of pancreas is hard but not materially enlarged. Owing to the fact that the patient has definite jaundice, I take a chance on the duodenal contents regurgitating back into the common

duct with the hope of temporarily relieving the intra-intestinal pressure on the smaller liver ducts. A tube the size of a lead pencil is passed into upper end of duct toward liver. The duct is sutured around the tube. A fold of omentum is drawn across the pylorus and duodenum and sutured to prevent reunion of stomach and raw surfaces.

This case had the complication of a stomach firmly adherent to the abdominal wall, therefore, some of the symptoms, notably the excessive gastric acidity might have been due to this, but it is hard to conceive of the stomach causing a real jaundice, and it certainly would not cause bile to appear in the urine after each attack of pain. The patient has been greatly relieved but still has some pain in the neighborhood at times. It is possible, of course, that even such extensive dilatation of the ducts as is shown in these cases may do no harm, but such conditions cause one to think. I am sure we would all prefer not to have such a duct.

ASEPTIC END-TO-END SUTURE OF INTESTINE

By John E. Scarff, M.D.

of Baltimore, Md.

From the Department of Surgery of the Johns Hopkins University

It was recently observed that if the walls of an empty loop of bowel are approximated and strongly crushed in a clamp the walls will adhere to each other quite firmly and the intestinal lumen remain occluded after the clamp has been removed.

This fact has been utilized in the development of an exceedingly simple and satisfactory technic for aseptic end-to-end anastomosis of intestine.

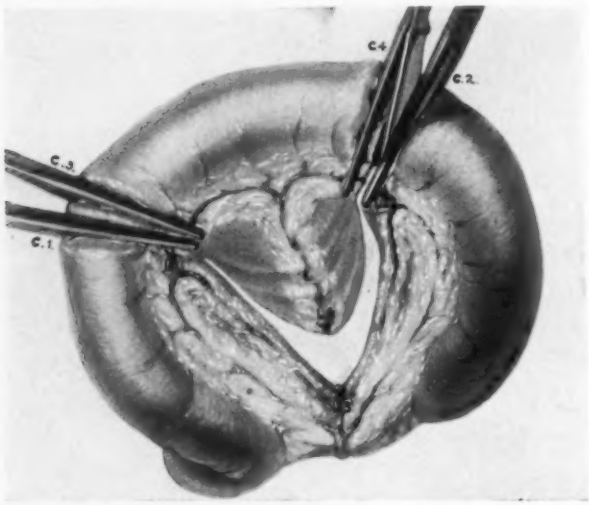

Fig. 1.—The method of controlling the blood supply of the bowel with fine silk sutures is shown in this illustration. Observe that the edges of the clamps C-1 and C-2 are placed in contact with the silk sutures L-1 and L-2. Also that the tips of the clamps C-3 and C-4 control all back bleeding from the loop which is to be removed.

Technic.—No special instruments are required. Blood supply is controlled by fine silk sutures as shown in Fig. 1, sutures marked L-1 and L-2 being placed near the radial arteries of supply. Medium Kocher clamps which have first been dipped in sterile white oil are now placed across the bowel in the manner shown in Fig. 1. The ends of all four clamps should extend across the longitudinal vessel in the mesentery. Extreme care should be taken that the lateral edges of clamps C-1 and C-2 just touch the fine silk ligatures L-1 and L-2. These clamps should cross the bowel somewhat obliquely so as to make the antimesenteric edge of the intestine which is to be sutured shorter than the mesenteric edge.[1] The success of the procedure following depends entirely upon the condition of the clamps. The grasping surfaces must oppose accurately and tightly throughout their whole length when the clamps are closed. The mesentery and bowel are then cut as shown in Fig. 1, and the diseased portion of the bowel between clamps 3 and 4 removed. It is particularly important that the edge of the knife should rest tightly against clamps C-1 and C-2 while the bowel is being divided, and that no loose shreds of tissue be left protruding beyond the clamps. The edges of the clamps are then touched with pure carbolic and alcohol.

Clamps C-1 and C-2 are now approximated and held in the operator's left hand, while Halsted mattress sutures of fine black silk threaded upon straight intestinal needles are laid as shown in Fig. 2. The first suture is placed in the bowel wall as near the mesenteric border as is possible, but so as to avoid carefully the mesentery itself, and the remaining sutures are placed at regular intervals between the mesenteric and the anti-mesenteric borders. For the time being these sutures are not tightened. The clamps are now turned over and the procedure repeated upon the other side of the bowel. All sutures are placed as close to the clamps as possible and the greatest care is exercised with each suture to take a deep bite and to pick up a part of the tough submucosal layer, for upon this latter point, as shown by Doctor Halsted,[2] depends the strength of the suture line. The work of Reichert and Holman [3] has shown that silk sutures may enter the lumen without endangering the strength of the anastomosis.

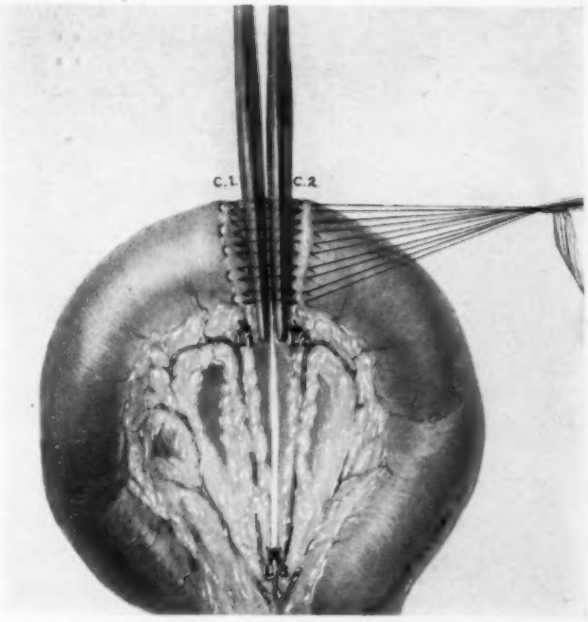

FIG. 2.—The clamps C-1 and C-2 are held together in one hand while Halsted mattress sutures of fine black silk threaded on straight intestinal needles are placed as shown. These sutures should be placed somewhat closer to the clamps than in the illustration.

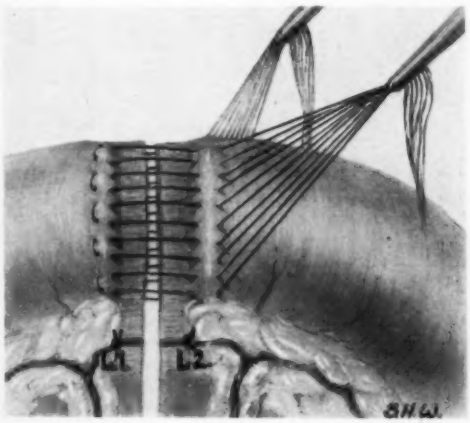

FIG. 3.—The Kocher clamps have been removed, leaving the crushed ends of the intestine tightly sealed. Note particularly that all of the tissues holding sutures have their blood supply, well preserved while the tissues to be inturned are thoroughly devitalized.

The clamps are now carefully removed one at a time. In doing this the bowel just behind the suture line is grasped by the thumb and forefinger of one hand, and the clamp closing that end of the bowel is grasped in the other. As the clamp is slowly and carefully opened, it is gently pulled away from the end of the bowel. It comes away smoothly, leaving the crushed end of the bowel tightly sealed (Fig. 3).

The small bits of mesentery which were crushed in the clamps are trimmed away, care being taken not to cut the ligatures on the longitudinal vessel. The free ends of the mattress sutures are then gathered up into two bundles (Fig. 3) and steady traction is made on them. This draws the two ends of bowel together, inverts the edges, and gives accurate approximation of the serosa before the mucosal layers have time to separate or permit leakage. After this, the individual sutures are tied one at a time without need of haste, care being taken not to draw the sutures too tightly. Lembert sutures may be interpolated between the mattress sutures if needed. The mesentery is repaired with interrupted sutures (Fig. 5). After the suture has been completed the continuity of the intestinal lumen is definitely reëstablished by simply pulling upon any two sutures which are upon the opposite sides of the bowel.

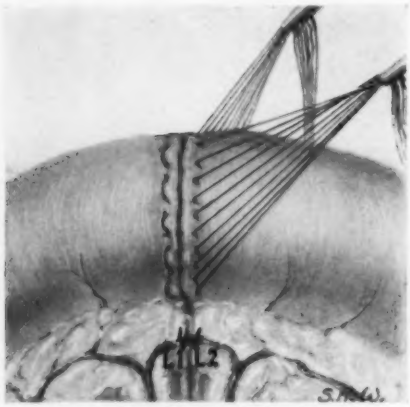

FIG. 4.—This illustration shows apposition of the ends of the intestine after traction on the free ends of the sutures. The individual sutures are now tied one at a time.

This procedure possesses certain advantages.

1. It is extremely simple.

2. No special instruments are required. This makes the method just as available in the unexpected emergency as in those cases where resection was anticipated.

3. The blood supply to the tissues holding the line of sutures is most carefully conserved. On the other hand, all the tissues to be turned in are not only crushed and devitalized, but deprived of their blood supply, which insures a minimal flange left within the bowel.

4. No hemorrhage is incurred during the procedure if it is properly carried out.

5. Except for the part to be inturned, the bowel is practically untouched by hand, instruments, or sponges during the anastomosis so that peritoneal trauma and the danger of subsequent adhesions is minimal.

FIG. 5.—Suture completed. The intestinal lumen has been reëstablished by pulling upon two sutures on opposite sides of the bowel.

6. Only interrupted mattress sutures are used, a factor for strength and safety in the anastomosis.

Intestinal suture by this method has been done twelve times in dogs. Two operations were performed each week for six weeks, at the end of which

time all the animals were sacrificed, following entirely uneventful post-operative courses.

In no case was there evidence of leakage at the suture line. In no case was the bowel dilated proximal to the anastomosis. In ten of the cases the omentum, which at time of operation had been placed about the bowel,

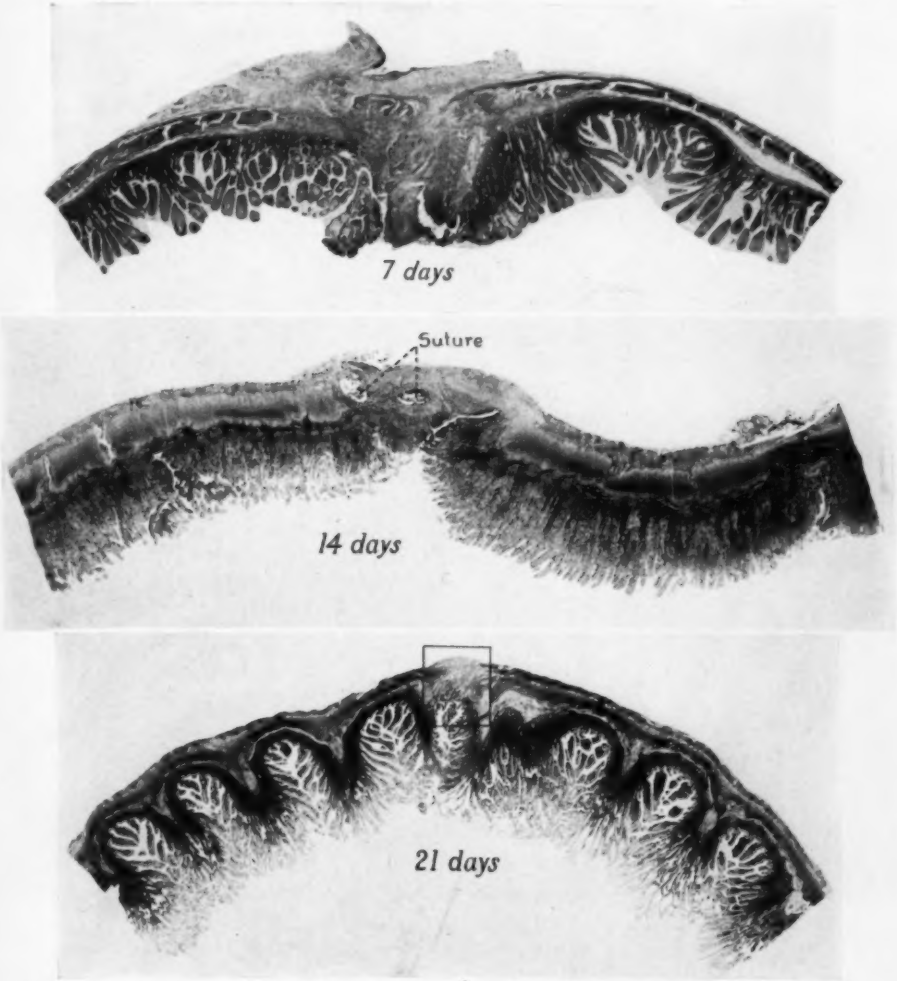

FIG. 6.—Three stages in the process of healing. *Upper:* Longitudinal section through anastomosis after seven days. Even at this early date practically no flange protrudes into the intestinal lumen, the tissue crushed by the clamps at operation having already sloughed away. A few adhesions are present at the suture line. *Middle:* Longitudinal section through anastomosis after fourteen days. There is no flange whatever and the point of union is completely covered with a thin layer of intestinal mucosa. *Lower:* Longitudinal section through anastomosis after twenty-one days. Complete repair of the mucosa has occurred. The muscularis has been replaced by connective tissue.

was mildly adherent to the line of suture; in one specimen there were no adhesions whatever; in one specimen the bowel was rather densely adherent to a neighboring loop of bowel.

The involution of the inturned flange is interesting. Even on the seventh day the devitalized portion of the inturn has disappeared. On the fourteenth

day the entire flange has flattened out, and low intestinal mucosa has spread across the defect. At the end of twenty-one days the restoration of intestinal mucosa is so complete that careful examination is necessary to determine the exact point of anastomosis (Figs. 6 and 7).

The observed fate of the silk sutures is in agreement with the observations of Reichert and Holman.[2] As early as the seventh day, several sutures were

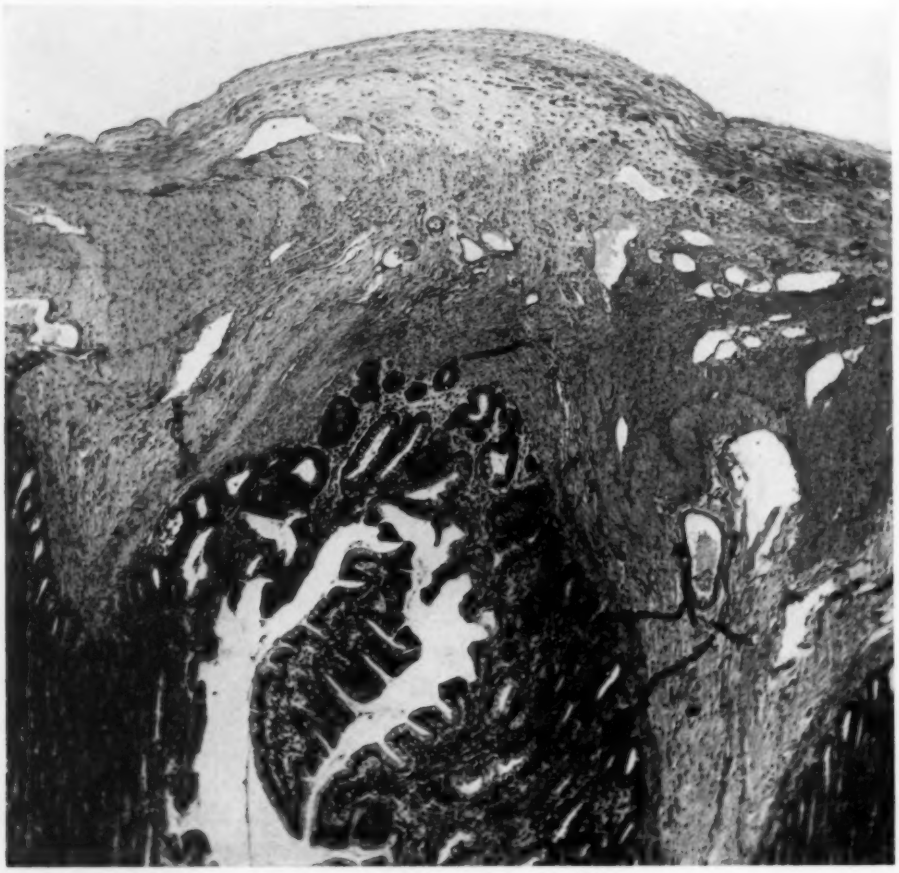

FIG. 7.—Microphotograph through the site of anastomosis in the twenty-one days specimen pictured in Fig. 6. There is practically no evidence of inflammatory reaction to the operative procedures.

found hanging almost free within the lumen of the intestine, but with the knot still buried within the bowel wall. About the third week, small white nodules were found on the outer surface of the bowel beneath the peritoneum composed of fresh granulation tissue containing cast-off silk sutures. In the older specimens this granulation tissue has changed to fibrous tissue and the nodules are smaller. Apparently the inward migration is an earlier process than the outward migration.

The method resembles somewhat the procedures developed by Moszkowicz,[4] Schoemaker,[5] Collins,[6] Pringle,[7] Parker and Kerr [8] and

Rostowzew.[9] It differs from each of these, however, in certain definite respects, all in the direction of greater technical simplicity.

SUMMARY

1. Attention has been directed to the fact that if the walls of an empty loop of intestine are approximated and strongly crushed in a clamp, the walls will adhere to each other quite firmly and the intestinal lumen will remain occluded after the clamp has been removed.

2. This fact has been utilized in the development of an exceedingly simple method of aseptic end-to-end suture of intestine.

3. This method of anastomosis has been used twelve times in dogs with very satisfactory results.

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TUBERCULOSIS OF THE CÆCUM*

By Joseph W. Larimore, M.D.

AND

Arthur O. Fisher, M.D.

of St. Louis, Mo.

FROM GASTRO-ENTEROLOGICAL SERVICE, DEPARTMENT OF SURGERY, WASHINGTON UNIVERSITY MEDICAL SCHOOL

Primary tuberculosis of the intestine in the adult is comparatively rare in this country. Tuberculosis of the intestine, secondary to pulmonary tuberculosis, is almost as frequent as is the fatal termination of pulmonary tuberculosis. It is a most frequent metastatic complication of pulmonary tuberculosis. Intestinal tuberculosis is seen in from 60 per cent. to 90 per cent. of cases at termination according to varying autopsy reports. The intestinal involvement centres at the ileo-cæcal segment. So much does this occur, it has been stated, without ileocæcal involvement there is no intestinal tuberculosis. Exceptions are rare.

Fig. 1.—Barium enema showing tolerance of cæcum to content but with an atypical contour of filling defect and spasm (no palpable mass), an incompetent ileo-cæcal valve and a "ragged" lumen of proximal appendix. (Case I.)

Tuberculosis of the intestine differentiates into three pathological forms—the hyperplastic, the fibrous, and the ulcerative. This difference in character

* Read before the Washington University Medical Society, January 12, 1925.

FIG. 2.—Gastric and duodenal hypotonicity with a tolerant cæcum at the six-hour period in Case II.

FIG. 3.—Case of extensive intestinal tuberculosis, showing at autopsy, lesions from the duodenum to the anus. Film taken at ten and one-half hours and shows the gross functional gastric motor insufficiency due to reflex inhibition.

is due to the different resultant of the varying virulence of the organism and of the difference in immunity of the patient when the infection takes hold of the intestine. Secondary intestinal tuberculosis is more usually acute and destructive, resulting in ulceration and tending to rapidly involve many segments of the intestine. Primary intestinal tuberculosis tends to remain localized and to be hyperplastic in character. Schwatt,[1] in a very careful study of autopsied cases of pulmonary tuberculosis, states that the onset of secondary intestinal tuberculosis ushers in the termination of the case in from three to six months. He also states that 50 per cent. of secondary intestinal tuberculosis is silent.

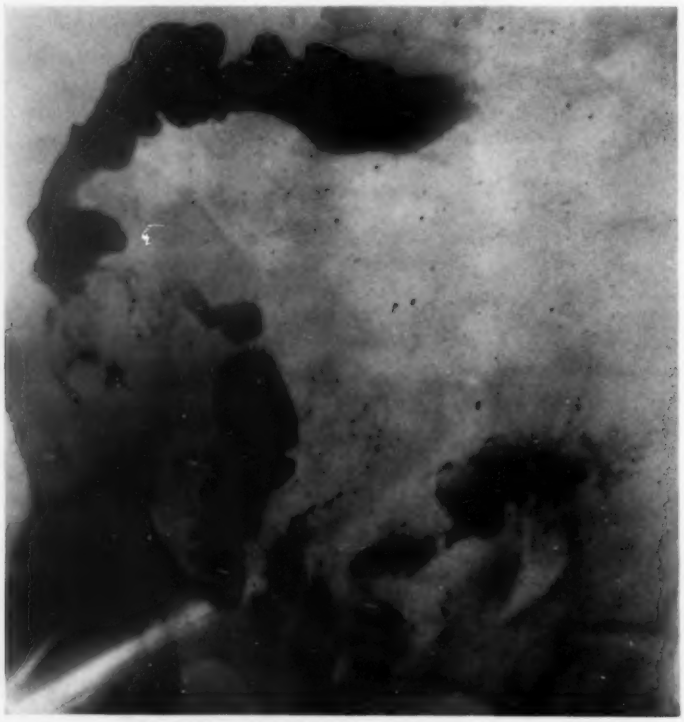

FIG. 4.—Case of advanced localized ileo-cæcal tuberculosis showing intolerance of the cæcum to bariu and a hyper-peristaltic phase of terminal ileum peristalsis.

The clinical picture of intestinal tuberculosis is not in its early phases conclusive, and it is not in itself diagnostic of that etiology but occurring in the subject of pulmonary tuberculosis it is presumptively certain. In subjects having no obvious or proven tuberculosis the same picture presents a difficult differential diagnosis from that of malignancy and of syphilis. (See Case VI.)

Clinical symptoms of primary intestinal tuberculosis are chiefly abdominal and, early, are those of partial mechanical obstruction of the intestine. Later the symptoms will be quite characteristic of this. It is not inferred that the obstruction is wholly mechanical. Spasm and disturbed peristalsis may superimpose a functional incomplete ileus. There may be few or no other symptoms of disease. In secondary tuberculosis these same symptoms may occur but the earlier symptoms are those of dyspepsia, fullness, nausea, discomfort, "gas," and anorexia. Vomiting may occur. Fairly characteristic and certain of intestinal involvement in the tuberculous subject is the diffuse pain in the right lower quadrant with "gas" or cramps, and fullness associated, soon after meals. Tenderness to palpation, rigidity of the abdominal wall, or a

FIG. 5.—Observation of fed test at the six-hour period in Case IV suggesting cæcal intolerance, which was demonstrated subsequently by fluoroscopic palpation. The gastric motor delay and relative colonic hypermotility support these suggestions.

FIG. 6.—Barium enema in a case of advanced cæcal tuberculosis, demonstrating the intolerance of the cæcum. The barium can be passed through and into the small intestine but is not retained sufficiently long in the cæcum to appear in the picture.

palpable mass may be found but are usually late occurrences. The status of bowel function may suggest intestinal involvement; the change of constipation to regular action without medical means, or the onset of a greater or lesser grade of diarrhœa. Diarrhœa is a late symptom and results from the irritation hyperperistalsis and later from the interference with the water-absorbing function of the bowel when generally involved. Localized tuberculosis of the cæcum permits normal total mobility of the colon.

FIG. 7.—Cæcum in Case I observed filled and retentive at the six-hour period, prior to any palpation.

The relation of the intestinal involvement as a determining cause to the fatal termination is problematic. It is certain that it occurs as a terminal incident in otherwise fatal pulmonary tuberculosis. It is also apparent that it occurs as a determining fatal complication in cases which are retrogressive as regards the pulmonary disease. In these cases it operates, first by superimposing an overload on the immunity and thus exhausting the resistance of the patient, and secondly by creating localized and reflex functional gastro-intestinal derangements which impair the total alimentary function and general nutrition. It is for the relief of these factors that surgery may be considered.

An early diagnosis of secondary tuberculosis of the intestine is essential to helpful surgical interference. The ileo-cæcal region only is involved in about 29 per cent. of the cases seen at autopsy. It is probable that of the 60 per cent. to 90 per cent. of cases which terminally show extensive intestinal

[Fig. 8.—Cæcum in Case I as observed after palpation which initiated peristalsis and spasm.

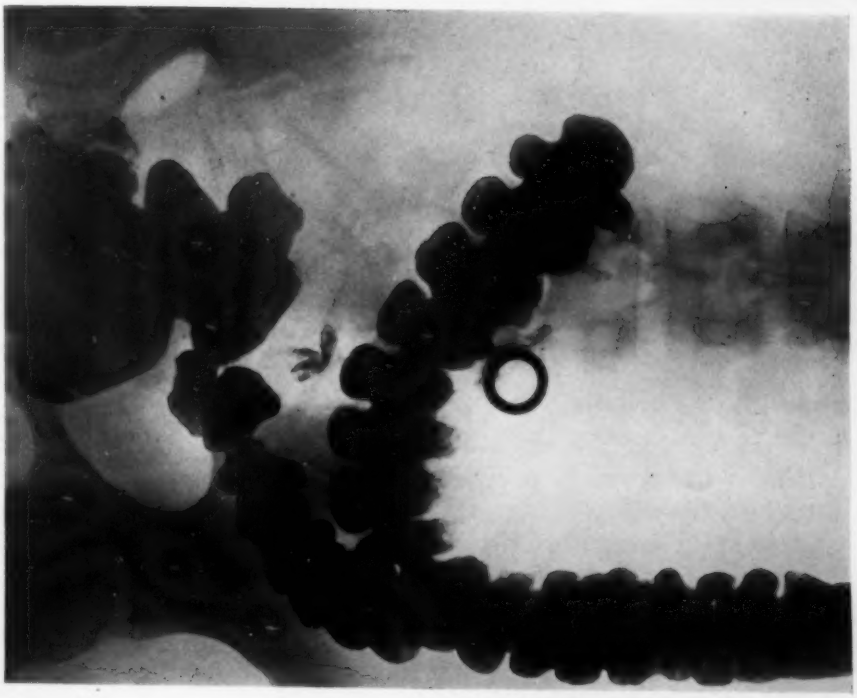

Fig. 9.—Case having only chronic appendicitis (operative confirmation) but with distribution of barium at 24 hours suggestive of pathological cæco-colic intolerance. Subsequent examination demonstrated an absence of irritability or other change in cæcum. It could not, by palpation, be caused to empty.

involvement, a larger proportion at some anti-mortem period will show a localized ileo-cæcal involvement which would permit of surgical interference.

Secondary intestinal tuberculosis to X-ray observation shows alterations of the intestinal contour by filling defects and spasms (Fig. 1) and associated disturbances of alimentary motility. Early secondary tuberculosis may be localized in the ileo-cæcal segment. The associated direct and reflex derangements of gastro-intestinal function as revealed by X-ray study are variable. There appears marked gastric motor delay (Fig. 2) with gastric hypotonicity (Fig. 2); total intestinal hypermotility with complete evacuation of barium in from eighteen to twenty-four hours, or with barium in the distal colon or rectum at six hours in spite of a gastric motor delay, the result of cæco-colic hypermotility. Gastric motility may be almost completely inhibited (Fig. 3). The principal sign of ileo-cæcal or cæco-colic tuberculosis is the progressively increasing intolerance of the cæcum to any content, which makes it non-retentive of barium (Fig. 4). In the late cases with extensive ulceration, this is readily demonstrated by any fed test (Fig. 5) or by barium enema (Fig. 6) and has been the classical sign of ileo-cæcal tuberculosis, as independently observed by Pirie,[2] and by Stierlin,[3] whose name it bears. An earlier phase of this intolerance was demonstrated in our ulcerative cases by fluoroscopic observation and palpation. The irritability of the cæcum at this very early stage, when its intolerance of barium is not so

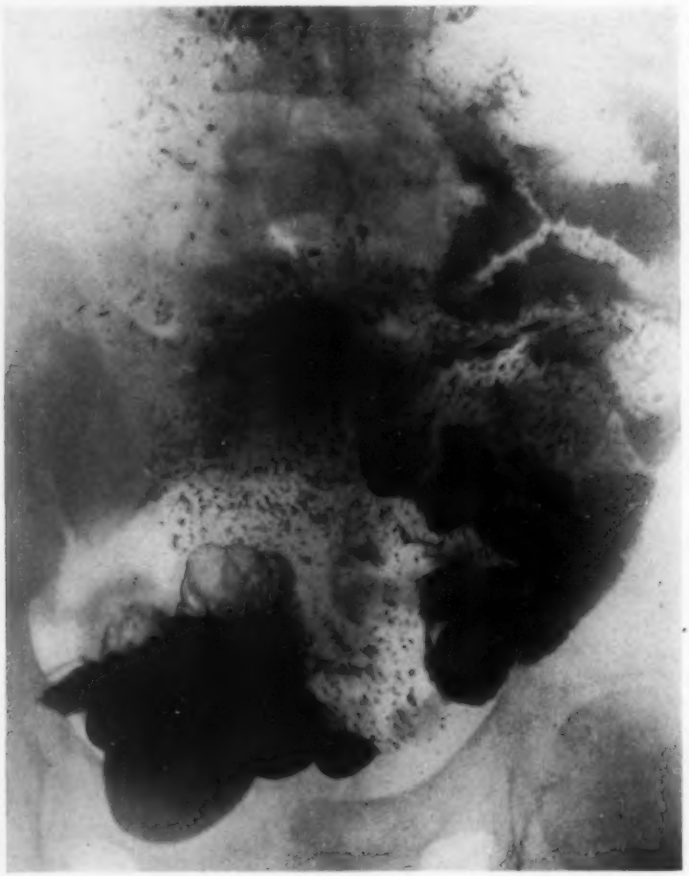

FIG. 10.—Case with small intestinal hypomotility at six hours, demonstrating failure of any clearance into the cæcum although the stomach has emptied. Recoil is shown in the loops of the ileum.

constant and absolute, can be demonstrated with fluoroscopic palpation. Palpation in these cases will, if the cæcum contains any barium, cause the cæcum and the ascending colon to promptly empty distally (Figs. 7 and 8). The observation is confirmatory of irritability when the cæco-colon will still show a retention of barium. When the cæcum is casually empty (Fig. 9) it will in further study negative the suggestions of involvement. I have in all cases secured, by palpation, peristalsis in the terminal ileum resulting in its clearance into the empty and relaxed cæcum which then with the ascending colon contracts and propells the barium mass distally. The cæco-colon then remains in spasm. Further peristalsis of the ileum cannot soon be elicited. This inhibition in the ileum may explain the frequent observation of a failure of small intestinal clearance (hypomotility) into the cæcum at the six-hour period (Fig. 10), although obstruction does not exist. Emptying of the cæcum following its palpation, I have observed in other than these cases of ileo-cæcal tuberculosis in only one instance, although palpation to determine cæcal mobility and appendiceal tenderness is a routine manœuvre. Emptying was elicited in this exception only after unusually extended palpation. The case was one of a large retro-peritoneal sarcoma in the right iliac fossa which had raised and displaced the cæcum to the left (Fig. 11). X-ray and clinical evidence of pulmonary tuberculosis (Fig. 12) contributed to the possibility of the abdominal lesion being tuberculosis. Resolution of the mass after deep Röntgen therapy supported the diagnosis of sarcoma which was not shown conclusively by the microscopical section.

FIG. 11.—Barium enema in a case of retro-peritoneal sarcoma showing displacement of the cæcum and its relative intolerance to content, the only case other than those of tuberculosis to give the reaction of irritation.

The demonstration in these five cases of an early localized ileo-cæcal involvement was supported by a lack of any X-ray evidence of other intestinal involvement which would have contra-indicated surgery. In these cases the diagnosis of intestinal involvement was clinically indeterminant. It was determined by the X-ray study. When intestinal involvement has become clinically certain, the pathology has usually advanced beyond the possibility of the surgical removal of the diseased segment of bowel.

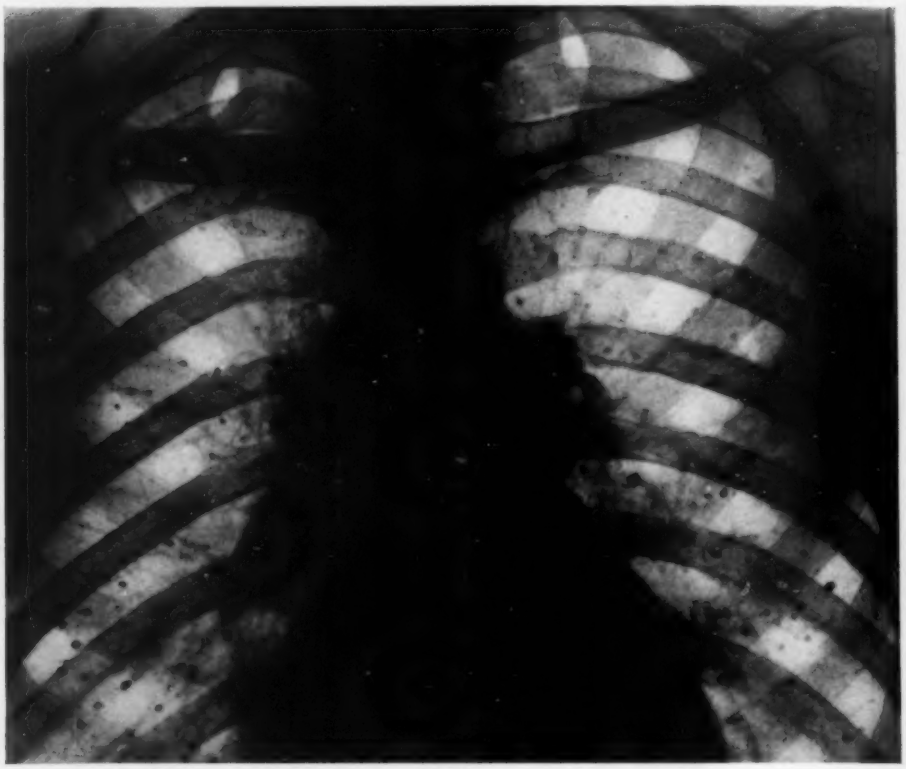

FIG. 12.—Chest film of same case as Fig. 11 showing evidence of healed pulmonary tuberculosis; and there were present clinical signs of activity.

CLINICAL RECORDS

CASE I.—G. C. W., white, female, single, aged nineteen years, had been a patient at the St. Louis Koch Hospital for Tuberculosis for the previous several months and at the time of admission to our service showed an advanced but retrogressive pulmonary tuberculosis with extensive involvement of both upper lobes (Fig. 13). For the preceding two months she had complained of slight cramping in the lower abdomen, more especially to the right, following meals. She had had some vomiting, however, always induced by coughing. There was slight, diffuse tenderness to palpation in the right lower quadrant without palpable mass. There was no rigidity.

X-ray examination showed a functional gastric motor insufficiency with a very small amount in the stomach at six hours. There was hypermotility of the proximal colon (Fig. 14). The cæcum had an atypical form with a narrow, irregular contour, showing a constriction at juncture of the cæcum and the ascending colon, definitely pathological

(Fig. 15). The cæcum was intolerant to barium, in that, although initially filled, peristalsis was elicited after extended palpation, and coincident with large clearance from the terminal ileum (Figs. 7 and 8). The peristalsis was slow, and emptied the cæcum into the ascending and the proximal transverse colons. The ileo-cæcal valve was incompetent. The valve was well opened by hyperperistalsis of the terminal ileum. The lack of clearance at six hours from the terminal ileum (total small intestinal hypermotility) in the initial examination, and only slight clearance on duplicate examination was due to reflex inhibition of the ileum. The cæcum and the terminal ileum were freely

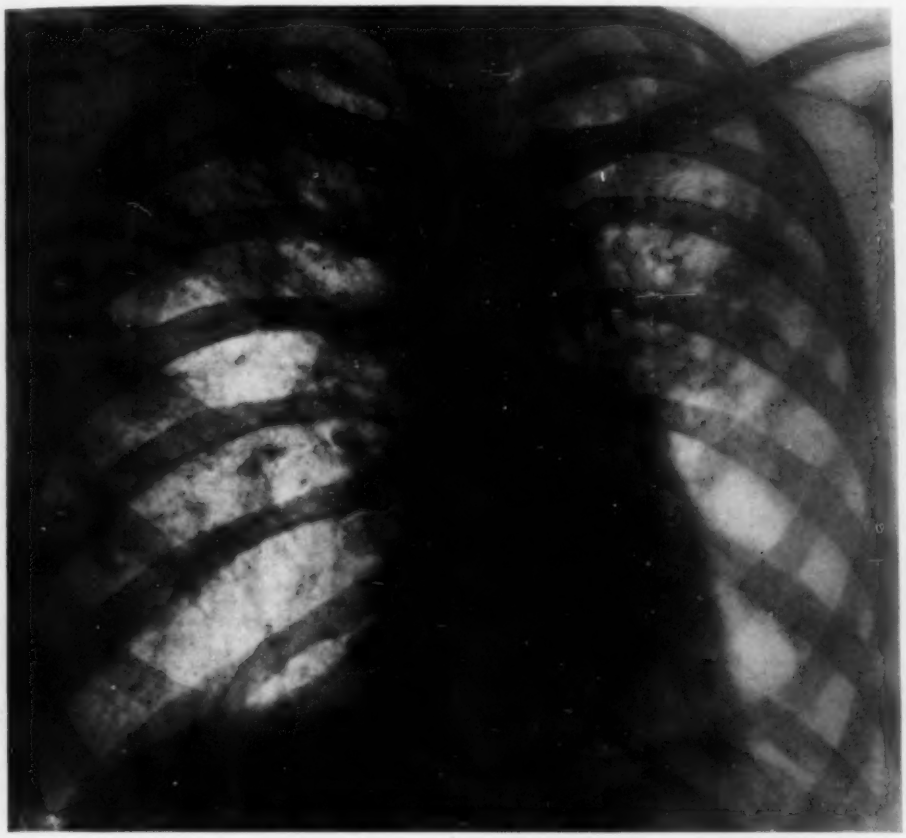

FIG. 13.—Chest showing pulmonary status of Case I at the time of operation.

movable. The appendix was visualized, filled in proximal portion only and palpable even in its unbariumized portion, with marked tenderness coinciding.

Conclusion (of X-ray examination): X-ray findings were conclusive of pathological involvement of the cæcum, the terminal ileum and the appendix, presumptively by tuberculous ulceration. Involvement of the ascending and proximal transverse colons was highly suggested but not conclusive. There was no extra-alimentary extension, and the conditions permit of surgical interference for resection.

Operation, August 11, 1924: *Resection of cæcum.* (Dr. A. O. Fisher.) Under twilight and local anæsthesia, right rectus incision through the muscle. No free fluid in the peritoneal cavity. The cæcum was readily delivered. The entire appendix was thick, indurated and stiff—typical of tuberculosis. This induration involved the cæcum which was also markedly thickened. The mesentery contained much fat and numerous glands. The abnormal condition of the cæcum apparently extended up to the hepatic

flexure and resection was decided upon. The terminal three or four inches of the ileum, the cæcum and a portion of the ascending colon liberated and removed in the usual manner; cut ends turned in and lateral anastomosis performed. There was practically no soiling and no bleeding. A rubber tissue drain was placed between the peritoneum and muscle. Wound closed in layers. Nitrous oxide given after resection was begun.

Gross pathology: (Dr. I. Y. Olch). The material (Figs. 16 and 17) consisted of a cæcum and an appendix. The walls were not thickened. Upon opening, the mucosa presented a moth-eaten appearance. It seemed to be converted into many small confluent

FIG. 14.—Observation at the 24 hour period (Case I) showing total colonic motor delay with proximal colonic hypermotility, suggestive of cæcal irritability, which was subsequently demonstrated. (Figs. 7 and 8.)

ulcers. No normal mucosa was seen, there were many small white areas which resembled small tubercles.

Microscopic pathology: (Doctor Olch.) Sections showed areas of ulceration. The mucosa was greatly infiltrated with round cells and eosinophiles. The submucosa was greatly thickened and also infiltrated with these cells. There were typical tubercles throughout the submucosa. Some contained giant cells and many giant cells were seen throughout the submucosa. Section of the appendix showed merely a round-cell infiltration of the submucosa. A lymph-node contained several typical tubercles and giant cells.

The post-operative course was uneventful. There was a transient slight but definite exacerbation in the pulmonary conditions. Subsequent gastro-intestinal function has been excellent on full regular diet including fruits and vegetables. Twelve months after the operation the patient is still under treatment at the Koch Hospital and is markedly improved as to pulmonary status.

CASE II.—A. M. O'C., white, female, single, aged twenty-seven years. The patient entered our service from her home, being referred by Dr. J. F. Bredeck from his private practice. She had been under treatment for one year with bed rest, only partial during later months, since the pulmonary condition was retrogressive. At this time the pulmonary condition was stationary with right, partial artificial pneumothorax (Fig. 18). The gastro-intestinal complaints were not characteristic of alimentary involvement—vomiting occurred frequently, and there was a soreness in the right lower abdominal quadrant. There was no diarrhœa. Physical examination showed only slight diffuse tenderness in the right lower abdomen.

X-ray examination showed gastric hypotonicity (Fig. 19) and a functional gastric motor insufficiency (Fig. 2); colonic hypermotility and atypical filling of the cæcum at six hours (fed test) with inadequate filling by barium enema. The appendix was not visualized.

FIG. 15.—Specimen as removed from Case I and yet unopened.

Operation: *Resection of the cæcum.* (Dr. A. O. Fisher.) Under twilight anæsthesia and gas, right rectus incision through the muscle. There was no free fluid in the peritoneal cavity and the parietal peritoneum was not involved. The liver was displaced downward, the edge being below the level of the umbilicus, but its appearance was normal. The transverse colon was delivered and followed down to the region of the cæcum, which was also delivered without difficulty. The cæcum and most of the ascending colon, together with the appendix and terminal ileum, were involved in an inflammatory process which was limited to this region. The bowel was stiff and mottled and presented the typical appearance of tuberculosis. The glands in the ileocæcal region were enlarged, but not broken down. The cæcum, most of the ascending colon, and the terminal three or four inches of the ileum were resected. The ends were turned in and a lateral anastomosis was made between the ileum and the transverse colon. There was very little bleeding and practically no soiling. The wound was closed in layers and a small rubber tissue drain inserted between the muscle and the peritoneum. The patient stood the operation very well and was awake before leaving the table.

Gross Pathology: (Dr. I. Y. Olch.) The material (Fig. 20) consisted of a cæcum with appendix and the end of the ileum. The walls were generally thickened. The mucosa was missing in patches, giving a moth-eaten appearance without definite delineated ulcer. Upon section the cut surface through the involved area did not show gross tuberculosis and this was probably an old or partially healed process.

Microscopic pathology: (Doctor Olch.) All sections showed the same picture.

FIG. 16.—Specimen of Case I opened.

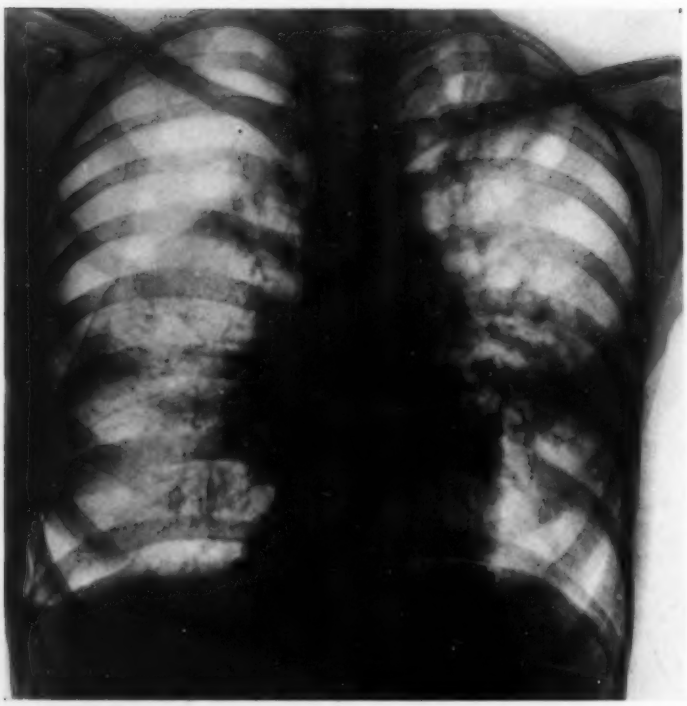

FIG. 17.—Showing pulmonary status with partial right pneumothorax existing in Case II at the time of operation.

The submucosa and the muscularis of the colon wall were greatly thickened. The mucosa was replaced in places by active granulation tissue. The wall was greatly infiltrated with round wandering and plasma cells and a large number of polymorphonuclear cells. In one section a nodule resembling a tubercle was seen, but was very atypical. No amœbæ were seen.

The patient's post-operative course was uneventful and before leaving the hospital she had taken for two weeks a full diet, including cooked fruits and vegetables, with excellent gastro-intestinal function and improvement of nutrition. This continued after she returned home. There was, however, an increase in pulmonary signs. She died six weeks after leaving the hospital. There was much vomiting during the last day, but abdominal examination was not notable for any sign suggesting post-operative complication.

FIG. 18.—Observation at the 24 hour period (Case II) showing proximal colonic hypermotility not evidenced at six hours (Fig. 2), and subsequently demonstrated by reaction to palpation to be due to cæcal irritability.

CASE III.—A. S., white, female, single, aged twenty-two years, had been a patient at the St. Louis Koch Hospital for Tuberculosis the previous seven months, and at the time of admission to our service showed a far-advanced pulmonary tuberculosis with a cavity in the left apex and also in the lower lobe (Fig. 21). The sputum showed acid-fast bacilli. The pulmonary condition was progressive at this time. For the previous two months she had persistently complained of abdominal cramps, belching and sour stomach and frequent nausea. More recently there had been tenderness to palpation in the right lower abdominal quadrant but without palpable mass.

X-ray examination showed gastric motility to be adequate in the six-hour period. The total colonic motility was over-prompt. The cæcum was relatively intolerant to barium but held sufficiently to secure a film (Fig. 22) by barium enema. This showed a ragged irritation contour of the cæcum and the ascending colon characteristic of an ulcerative colitis. Pathological changes cease at the hepatic flexure, and the colon distally shows normal contour. Fluoroscopically the reaction is characteristic of an ulcerative lesion. Initially there was very scant barium in the cæcum, but during the observation the terminal ileum emptied, and the cæcum immediately and promptly projected the barium mass distally, and it was carried promptly into the distal transverse colon. This reaction followed promptly a clearance from the terminal ileum. Slight palpation of the cæcum and the terminal ileum had immediately proceeded. Tenderness was greatest

to direct palpation of the cæcum. The ileo-cæcal valve was incompetent. The appendix was not visualized and is probably involved in ileo-cæcal pathology. The cæcum was movable.

Conclusion (of X-ray examination): Pathology is limited to the cæcum and the ascending colon and the appendix, and is probably of tuberculous origin. Involvement is sufficiently localized and early to permit local surgical interference for resection and anastomosis.

Operation: *Resection of the cæcum.* (Dr. A. O. Fisher.) Under twilight and gas anæsthesia, a right rectus incision was made through the muscle. No free fluid in the peritoneal cavity. The cæcum was injected and covered with fibrin; the appendix was a large, thick, fibrous structure suggestive of tuberculosis; the wall of the cæcum was also thickened and indurated. This induration extended almost to the hepatic flexure. At this point the omentum was densely adherent to it. It was easy to mobilize the cæcum and resection was done. The lower three to four inches of the terminal ileum, the cæcum and the ascending colon were removed, although there was no evidence of disease in the ileum. The cut ends were turned in with double purse-string sutures, reinforced later with continuous silk sutures. Numerous enlarged glands were present but all were soft. The raw surface left on removal of intestine was covered with peritoneum. Side-to-side anastomosis was then done between the terminal ileum and the large intestine using two layers of catgut. The end of the large bowel was covered with omentum and the two loose ends of intestine anchored to the adjacent bowel. An adequate stoma was left and there was practically no soiling during the operation. At this point the entire team changed gowns and gloves. The abdominal wound was closed in layers without drainage. The patient was carried on gas except for a short period when the cæcum was being resected, during which time she had about two ounces of ether. She left the table in good condition.

FIG. 19.—Opened specimen of resected cæcum from Case II.

Gross pathology: (Dr. I. Y. Olch.) The material consisted of the cæcum and the appendix and the terminal ileum. Around the ileo-cæcal valve were several small patches where the mucosa was missing, leaving small ulcers which were irregular and had a moth-eaten appearance. Several of these ulcers were found in the lower portion of the cæcum. The ileum was normal. The appendix was 8 cm. long, thickened, and its

mucous membrane was dark and injected. Several lymph-nodes were enlarged. The mucosa and muscularis were thickened and more or less injected.

Microscopic pathology: (Doctor Olch.) Section showed a small area where the mucosa was missing and replaced by granulation tissue. The submucosa was thickened generally and there was marked round-cell infiltration throughout all layers. Here and there in the submucosa were seen several small tubercles. Lymph-nodes showed several small tubercles, each containing giant cells.

Case IV.—M. H. S., white, female, single, aged twenty-two years. The patient entered our service from her home, being referred by Dr. J. F. Bredeck from his

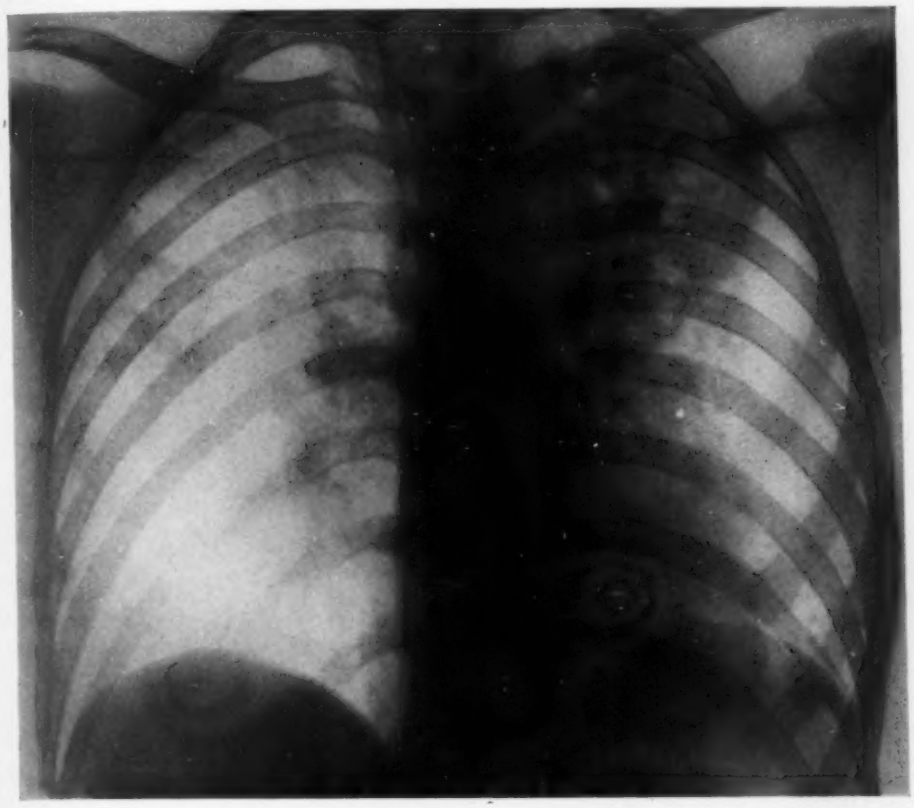

Fig. 20.—Chest showing pulmonary status at the time of operation in Case III.

private practice. She had been under treatment with complete bed rest for eighteen months. The pulmonary condition was stationary with complete involvement of the left lung (Fig. 23). The gastro-intestinal symptoms were wholly of the character of a secondary dyspepsia with a chief complaint of nausea without vomiting. There was no pain or diarrhœa. No abdominal mass or tenderness could be found.

X-ray examination showed the stomach hypotonic with, however, normal total motility (empty within six hours). The pyloric ring was patulous and incompetent. The duodenum was generally hypotonic. The appendix was not visualized and had no local tenderness. The reaction of the cæcum to palpation was highly suggestive of pathology. The cæcum and the proximal colon showed hypermotility (Fig. 5); however, the cæcum filled well and retained barium in the barium enema. The cæcum was noted in the fluoroscopic examination in hyperperistaltic movement initiated by a large clearance from the terminal ileum, which was immediately passed into the distal transverse colon

and the cæco-colon then persisted in spastic contraction. There was no tenderness associated with palpation of the cæcum. There was marked colonic hypermotility associated with a rectal residual constipation.

Operation: *Resection of the cæcum.* (Dr. A. O. Fisher.) Under twilight and local anæsthesia, incision was made through the right rectus muscle. The peritoneum was not involved. There was no free fluid. The cæcum was readily delivered. The appendix was greatly thickened, mottled, and was typical of a tuberculous process. The cæcum was likewise thickened. The terminal ileum was normal. The mesenteric glands were definitely palpable but not greatly enlarged or caseous. The mesentery was divided, but this could not be done without causing a considerable amount of pain, so that she was given gas from this point on and took it nicely. The cæcum and the terminal ileum were mobilized without difficulty and excised. The ends were turned in with double sutures and a lateral anastomosis was made between the ileum and the ascending colon. The entire operation was done outside the peritoneal cavity so that there was practically no soiling. After the anastomosis was finished, gowns, gloves, instruments and linen were changed in order to prevent any soiling of the wound. The wound was closed without drainage, except for a small rubber tissue drain placed between the peritoneum and rectus muscle. The patient stood the operation remarkably well and left the table in excellent condition. She was awake on reaching the ward.

FIG. 21.—Barium enema in Case III demonstrating tolerance of the cæcum which has an equivocal contour. Irritability of the cæcum was demonstrated by palpation when it filled in the fed test.

Gross pathology: (Dr. I. Y. Olch.) The material (Figs. 24 and 25) consisted of a cæcum, the ileo-cæcal junction and the appendix. The mucosa was intact, but at one place in the cæcum the tissue felt rather firm. The appendix was greatly thickened, 5 cm. long, and appeared pathological. The end of the ileum was normal. One large lymph-node (1.5 cm.) at the ileo-cæcal junction.

Microscopic pathology: (Doctor Olch.) Sections of the colon and the ileum showed the mucosa intact with the exception of one small area where it was eroded.

In this area of erosion and undermining of the adjacent mucosa there where great numbers of lymphocytes. In several places small tubercles were seen, in the centre of each was one or more giant cells. Section of the appendix showed the submucosa and wall thickened and greatly infiltrated with round cells in one place, beneath the mucosa was a tubercle with three giant cells.

This patient had an uneventful post-operative course, with excellent healing of the wound. Subsequent gastro-intestinal function was excellent and symptomless. Doctor Bredeck stated that all problems of alimentation were corrected by the operation. There was a slow progression of the pulmonary disease and the patient died eight months after the operation.

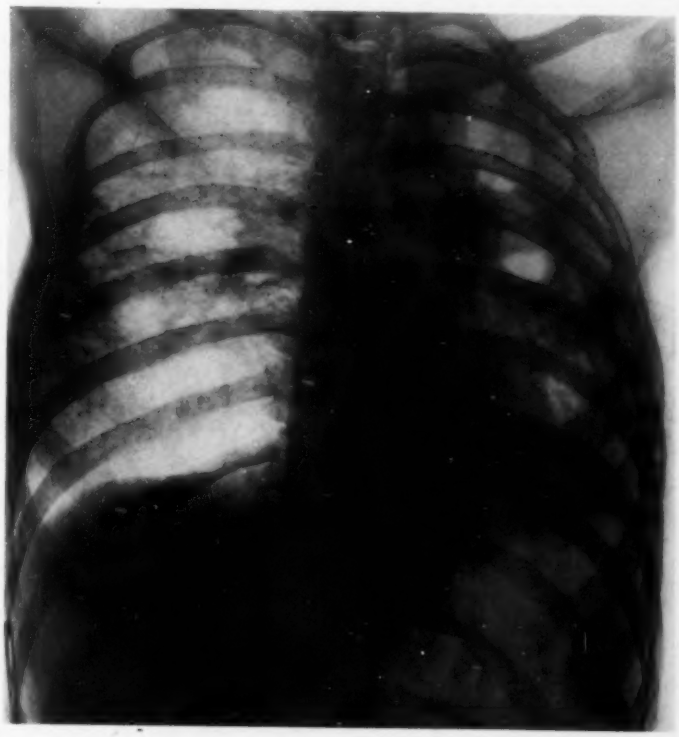

FIG. 22.—Chest showing pulmonary status in Case IV at the time of operation.

CASE V.—E. C., white, female, single, aged twenty years. The patient entered our service from her home, where she had been treated for proven pulmonary tuberculosis (Fig. 26), with bed rest for nine months under the care of Dr. S. B. Grant. She had had in the preceding four months four bowel actions daily and cramps ("gas") in the lower abdomen following all meals. Vomiting occurred only when induced by coughing. She had artificial pneumothorax established prior to operation. This case died suddenly five days post-operative from cardio-respiratory complication.

X-ray examination showed adequate gastric motility. There was colonic hypermotility with almost complete evacuation of barium at eight hours and the cæcum showed hyperirritability. There was tenderness to pressure over the cæcum and the terminal ileum, greater over the latter. The terminal ileum was freely movable and the cæcum was slightly fixed. The cæcum was tolerant to barium enema (Fig. 27). In special examination, vigorous palpation resulted in the emptying of the terminal ileum into the cæcum and then cæcal contraction with projection distally of its barium mass (Figs. 28 and 29). This reaction is characteristic of cæcal involvement of the ulcerative type. The ileo-cæcal valve was incompetent. The appendix was not visualized.

Operation: Resection of cæco-colon. (Dr. A. O. Fisher.) Right rectus incision through the muscle. Fair layer of fat in abdominal wall. Plenty of fat throughout peritoneal cavity in mesentery and omentum. No free fluid. The appendix was found to be a thick, indurated, œdematous structure, considerably enlarged, and had the mottled grayish appearance which is suggestive of tuberculosis. The cæcum was markedly

thickened and the mesentery was adherent to its outer surface. This process extended up to the hepatic flexure. The remaining large bowel seemed normal. The glands were not definitely enlarged. A few were removed for examination. The terminal ileum was negative. The cæcum with a few inches of terminal ileum and most of the ascending colon were resected. The ends were turned in with double catgut sutures reinforced with silk, and a lateral anastomosis made between the ileum and the transverse colon. There was very little soiling and after the anastomosis there was a complete change of instruments, gloves and gowns. Wound closed in layers without drainage. Patient stood operation very well.

Specimen was examined immediately after operation and on opening it there were many definite small irregular ulcers in the wall of the cæcum and in all probability some of the involved cæcum was left behind. It was difficult to tell by palpation just how far up these lesions extended and to know, therefore, how much to take away. It was noted in this case, however, that the omentum was adherent to the bowel over the entire area which was removed and somewhat beyond it. It is possible that this may be helpful in determining the extent of the lesion.

FIG. 23.—Specimen of resected cæcum unopened from Case IV.

Gross pathology: (Dr. I. Y. Olch.) The material consisted of a cæcum with about 7 cm. of the ascending colon and about 3 cm. of the terminal ileum. The appendix was 6 cm. long and thickened. On the serosa of the cæcum there was a rather diffuse white scarring. The wall of the gut was everywhere thickened. The mucosa of the ileum and the ileo-cæcal valve were normal. On the mucosa of the ileum were several irregular, shallow ulcers each with a necrotic base. The appendix also contained these ulcers.

Microscopic pathology: (Doctor Olch.) Sections showed intestine in which the mucosa was missing in places, especially between the folds. The submucosa was thickened and infiltrated with many round cells, and showed many tubercles containing one or more giant cells. The process here evidently started in the submucosa and extended later to the mucosa and the muscularis.

In contrast to the five operated cases of secondary early ulcerative cæcal involvement is the following case of early primary tuberculoma of the cæcum:

CASE VI.—P. J. R., colored, male, married, aged twenty-four years. Patient entered Barnes Hospital from the out-patient department with a diagnosis of chronic appendicitis. He had had for six months a constant, dull ache in the right lower quadrant varying somewhat in degree. Treatment and attention to the bowels had been without influence. Physical examination showed a palpable mass the size of a large lemon, freely movable,

firm and moderately tender. The lungs were not notable by physical examination or X-ray (Fig. 31). There was a slight afternoon temperature.

X-ray examination showed a gross filling defect of the distal cæcum and the proximal ascending colon and coinciding with the palpable mass in the lower right quadrant and accompanied by hypermotility of the cæcum. The tumor may be neoplastic or inflammatory. The general contour, consistency and tenderness were more suggestive of adenoma; however, the same picture could be produced by chronic inflammatory disease—tuberculosis or lues. Tuberculosis was suggested by the hypermotility of the distal cæcum. There was stasis in the terminal cæcum. The appendix was visualized, poorly filled and showing contracted lumen. Conclusion: Tumor of the cæcum with evidence in favor of a neoplasm. Situation, one requiring operative interference.

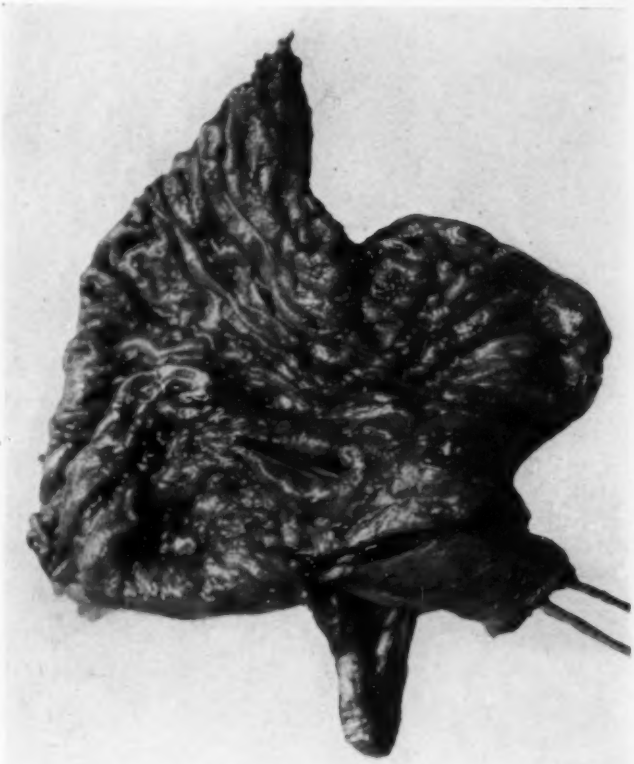

FIG. 24.—Same specimen as in Fig. 23, opened. (Case IV.)

Operation: *Resection of the cæcum.* (Dr. A. O. Fisher.) A right rectus incision through the muscle. There was no free fluid. The cæcum was œdematous and the seat of an extensive tuberculous process which involved the entire head of the cæcum, one-half of the ascending colon, the ileo-cæcal valve and the terminal ileum. Numerous masses of retroperitoneal glands were felt throughout the peritoneal cavity. There were several very large glands lying in the angle between the ileum and the cæcum. One of these was quite soft and caseous and was broken into in our manipulation. There was no evident involvement of the parietal peritoneum. It was thought advisable to resect the tuberculous cæcum in the first place to prevent occlusion which would probably follow before long and to eliminate the supposed primary focus. The cæcum was mobilized without much difficulty. Practically the entire ascending colon with the cæcum and with about 10 cm. of the terminal ileum were removed in one mass. The ends were turned in and a lateral anastomosis was made between the terminal ileum and the transverse colon. There was relatively slight soiling. Wound closed without drainage except for a small rubber tissue drain between the peritoneum and the muscle.

Microscopic pathology: (Dr. I. Y. Olch.) All sections showed intestinal wall, the mucosa of which was fairly intact. The submucosa and muscularis were greatly infiltrated with vast numbers of lymphocytes, wandering cells and some eosinophiles. Many typical tubercles were seen with many giant cells.

This patient had an uneventful post-operative course and was promptly discharged from the hospital. Post-operative examination had shown excellent anatomical and functional conditions and the patient is pursuing a normal life with heavy work.

DISCUSSION

The involvement of the intestine secondary to pulmonary tuberculosis constitutes a major handicap to treatment of the primary disease. Medical management of the intestinal complication must, as its first measure, adjust the diet in a manner as to inevitably limit rather than increase total nutrition,

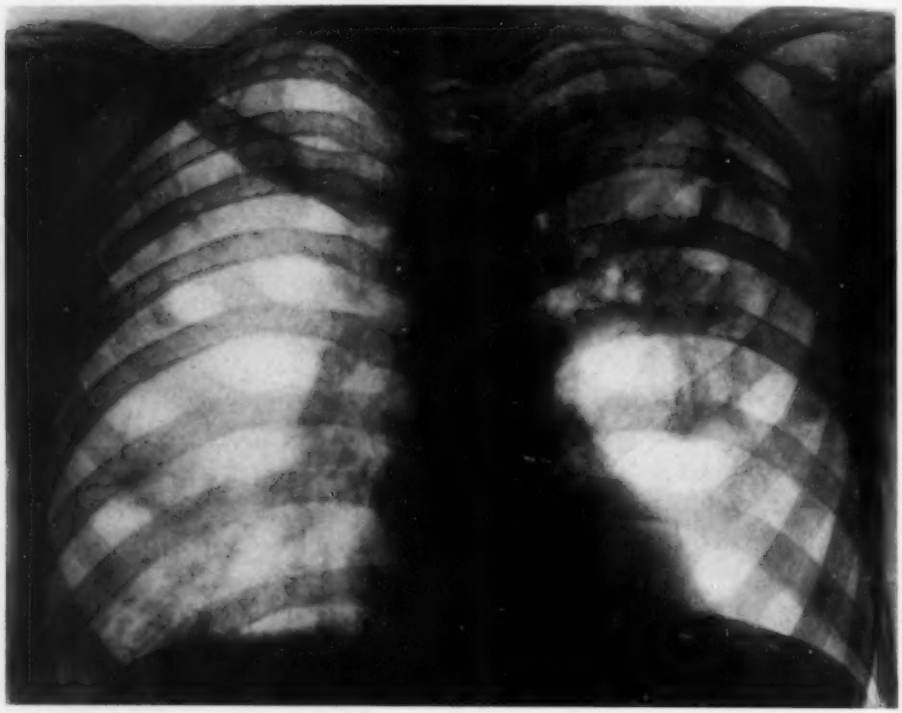

FIG. 25.—Chest showing pulmonary status at the time of operation in Case V.

even in the earliest stages of the intestinal involvement. Symptoms in the later stages obviate even adequate nutrition and in themselves so exhaust the patient as to hasten if not induce the fatal termination. It is not surprising that an absolutely unfavorable prognosis should be claimed in the presence of this complication. In our observations at the St. Louis Koch Hospital for Tuberculosis there has appeared no method of treatment or other reason to demur from that position. Heliotherapy has not yet yielded for us the curative results as reported by others. In those cases in which we could determine favorable early intestinal localization of the disease, we have had no hesitancy in offering the patients the chance to improve their general prognosis by surgical interference. Always they have been told of the full immediate surgical risk and, of the nature of the procedure as remedial to a complication. The cases that have so far come to our observation have had far advanced

pulmonary disease and the greater number could not be considered as subjects for surgery. Of the five cases operated, none could be given a good prognosis for their pulmonary status alone. Cases in which the pulmonary status may be so favorable as to justify urging a recourse to surgery will be infrequent. Of our five operated cases, one is living after one year and improving and is without gastro-intestinal symptoms; one died post-operatively in the hospital and three died after leaving the hospital. These three, until the terminal period, gave no further gastro-intestinal symptoms.

FIG. 26.—Barium enema in Case V giving no suggestion of pathological involvement of the cæcum. Irritability of the cæcum was demonstrated by palpation in the fed test. (Figs. 27 and 28.)

The diagnosis has been established in these five cases at a very early period of the intestinal disease when the operation could be directed to removal of the disease rather than to palliation of an urgent symptom. The evidence of gross pathology in the bowel before its resection and opening was slight and in one case there was none. In two cases the appendix alone showed any gross evidence of disease and without the pre-operative diagnostic studies there would have appeared no reason to do more than an appendectomy. Two cases showed no significant pathological change in the appendix and we do not believe the position, that the appendix is the first site of intestinal localization, is tenable.

This small series of cases has been satisfactory in regard (1) to the very early determination of the intestinal disease; (2) in the highly satisfactory tolerance of their pulmonary condition to the conditions and sequence of

FIG. 28.—The same cæcum as in Fig. 27, as observed in peristalsis and spasm elicited by palpation.

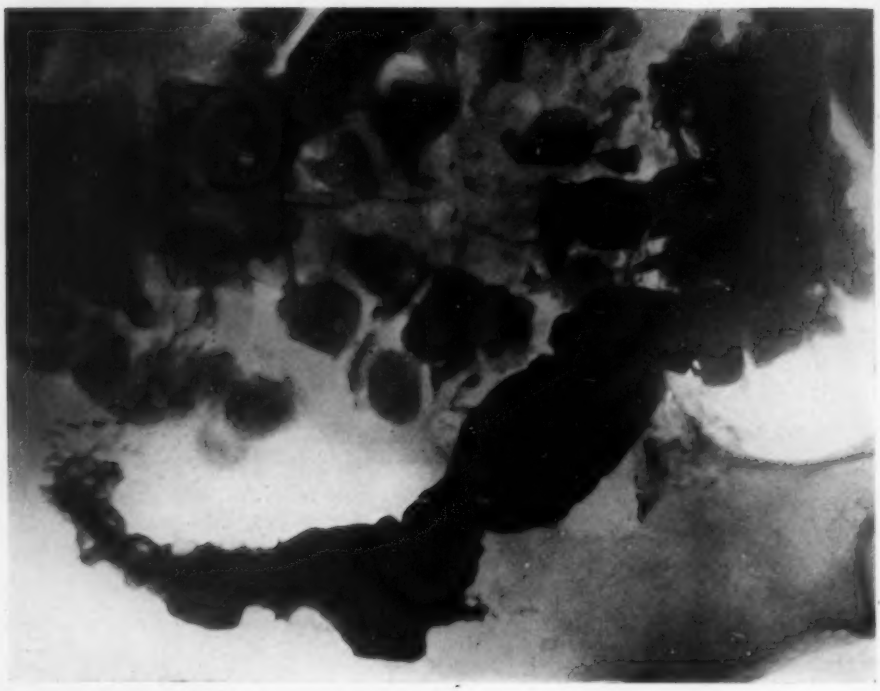

FIG. 27.—Cæcum in Case V as observed filled at the six-hour period.

laparotomy; (3) in the uniform improvement of their gastro-intestinal function, and (4) in definitely changing the prognosis in one of five cases.

SURGICAL NOTE

Surgical interference has been undertaken frequently in cases of tuberculoma or the hyperplastic type of intestinal tuberculosis, which is illustrated by the last case in this series and mentioned in order to contrast it with the ulcerative type in which we are particularly interested. Tuberculoma is a well-

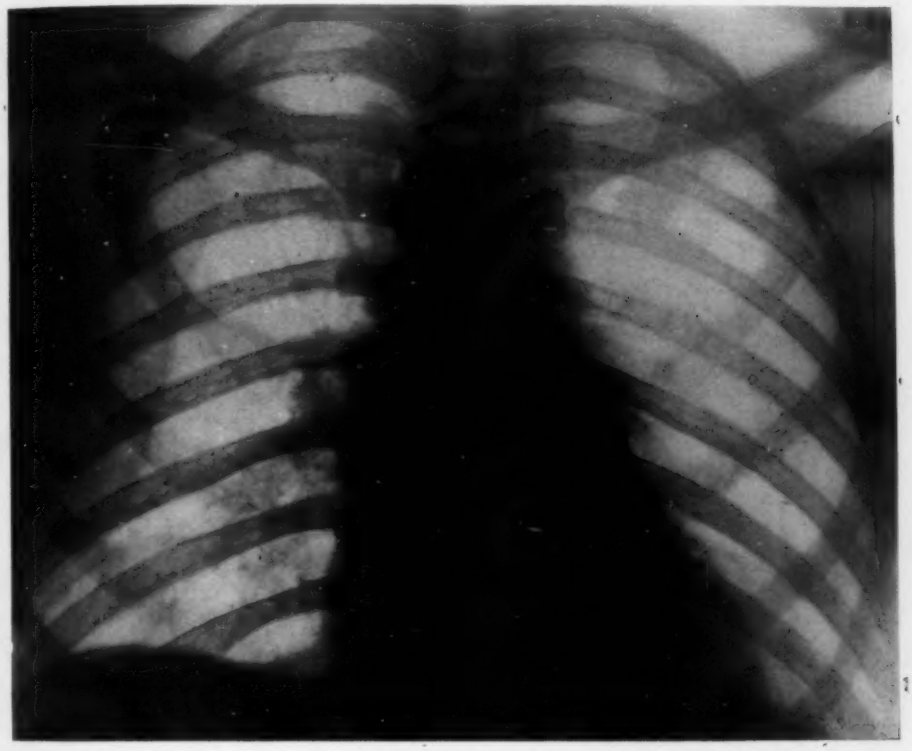

FIG. 29.—Showing pulmonary status at the time of operation in Case VI with no evidence of pathology.

recognized condition and has often been described. It is generally agreed that such cases frequently demand surgical treatment, but one gains the impression that this is done not so much for the purpose of eliminating the tuberculous process as it is to determine the question of malignancy in doubtful cases of tumor, or as an emergency measure to relieve obstruction. The results of resection of the cæcum in these cases, when it is technically possible, are usually very satisfactory. Not infrequently, such patients are relatively free from tuberculosis elsewhere and so far as can be determined, the cæcum is the primary focus of infection. Just as in cases of malignant disease, an early diagnosis is of the greatest importance and an X-ray study of the intestinal tract could hardly fail to discover such a lesion.

Our attention, however, has been chiefly directed to those cases of pulmo-

nary tuberculosis, in which the cæcum had become involved in a secondary ulcerative process, a condition which is usually progressive and terminal. With a patient unable to retain and assimilate food, the struggle against tuberculosis is hopeless. In spite of the very general opinion that surgery has little to offer under these circumstances, we feel that the results which we have thus far obtained, show that operation is definitely indicated in carefully selected cases. A resection of the cæcum, even in patients who are not handicapped by pulmonary disease, is a major operative procedure, but in this series we had but one operative mortality and in general the convalescence has been uneventful and satisfactory. In no case was there a continued exacerbation of the chest condition and primary wound healing was always obtained. Obviously, infection is one of the greatest dangers in all operative procedures on the large bowel, but by avoiding unnecessary trauma and following a very rigid technic, this danger is slight. It is really surprising how well these people stand operation.

FIG. 30.—Localized view of the cæcum in Case VI showing the gross filling defects co-inciding with a palpable mass and making a difficult differential diagnosis between tuberculoma and malignancy.

It is rarely necessary to employ ether as an anæsthetic, but we would not hesitate to do so if other methods were unavailable. Twilight sleep supplemented by novocaine locally has usually sufficed until the mobilization of the cæcum was undertaken. During this procedure nitrous oxide was given and again during the closure of the peritoneum, although it was not necessary during the actual resection and anastomosis. The patients were usually awake on reaching the ward.

The incision through the right rectus muscle should be ample in order to have easy access to the entire ascending colon and the hepatic flexure and to

avoid the necessity of undue retraction and trauma of the wound. Occasionally we have been in doubt as to the exact extent of the lesion. In one case there was no visible or palpable evidence of the disease in the cæcum and without the X-ray evidence, resection would not have been justified. It is much better to go well beyond any questionable area than run the risk of leaving behind diseased bowel. The involved area is usually more or less thickened and has an injected, grayish, mottled appearance, and in one case the omentum was adherent over the diseased portion. Thus far our operative cases have never shown involvement beyond the hepatic flexure nor in the terminal ileum. To facilitate the technic, the terminal three or four inches of the ileum are usually included in the resection. After mobilization, the part to be resected is brought out of the abdomen and the peritoneal cavity and wound edges are very carefully protected with gauze packs. This protection must be scrupulously maintained during the resection and anastomosis. I have made use of a lateral anastomosis between the terminal ileum and the transverse colon and have chosen this method because of its simplicity and safety, and it has given uniformly good post-operative results. At this point in the operation we make a complete change of everything which could have become contaminated during the resection and in this way run little risk of peritoneal or wound infection. Formerly we placed a rubber tissue

FIG. 31.—Fed test in the same case as Fig. 30 showing disturbed motilities more suggestive of cæcal tuberculosis.

drain between the peritoneum and the rectus muscle, but this has been abandoned and the wounds are now closed without drainage.

The post-operative treatment is not unlike any other similar case. Fluids are given subcutaneously on the first day and water by mouth is permitted as soon as desired. By the third day patients are usually on a soft diet. It is important, of course, that no rectal treatments be given. It has been interesting to note that the abdominal symptoms have cleared up very rapidly and they are soon able to take a carefully regulated but liberal diet.

We are encouraged by the results thus far obtained. All of the cases in this group have had extensive pulmonary disease and their condition without operation was hopeless. They were relieved of a tremendous amount of discomfort and given a better chance of recovery. It is reasonable to suppose that cases with less pulmonary disease will be helped much more and by means of the X-ray it will be possible to detect such cases and determine the extent and operability of their lesions. In selected cases surgery is not only justified but definitely indicated.

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EXPERIMENTAL RESULTS IN THE USE OF DEAD FASCIA GRAFTS FOR HERNIA REPAIR

By Amos R. Koontz, M.D.

of Baltimore, Md.

From the Surgical Hunterian Laboratory of the Johns Hopkins Medical School

Recently the use of dead material as grafts in the repair of anatomical defects has created widespread interest. This has been due principally to the work of Nageotte and Sencert. These authors have reported the transplantation of pieces of tendon preserved in alcohol or formalin to repair defects in living tendon. Their work has been extensive and their results excellent. A short review of their work, and of events leading up to it, is essential as a preliminary to the recounting of the work reported in this paper.

Fig. 1.—Piece of alcohol-preserved dead fascia grafted into the fascia lata of a dog. Removed six months after operation. The black silk sutures indicate the position of the graft.

Before taking up the experimental and clinical work of Nageotte and Sencert, it is desirable to consider a theory of the nature and origin of connective tissue formulated by Nageotte in 1916, and which forms a basis for his subsequent experimental work. For many years there have been in existence two main theories as to the origin of the connective tissues: (1) The exoplasm theory, held principally by Hansen, Mall, Szily, Studnička, and Laguesse. There are several variations of this theory, but, in general, its adherents claim that connective tissue is formed from transformed portions of protoplasm—the exoplasm, which comes from a syncytium of mesenchyme cells. (2) The cellular secretions theory, held principally by Merkel. This theory claims that early syncytium of the mesenchyme cells secretes an amorphous gelatinous non-living ground substance in which the connective-tissue fibres form. In contradistinction to these two theories, Nageotte believes that albuminoid coagula are first formed by the humors of the organism or from the parenchyma cells and that these coagula are no more living than the coral of polyps; that the problem of origin is the same as that of formation of blood plasma. This fundamental substance (substance fondamentale) is not amorphous, but composed of elementary collagen fibrils (fibrille collagène élémentaire). These elementary collagen fibrils give rise to collagen fibres, and connective tissue is formed by the penetration of fibroblasts into the meshes of fibres. The distinctive feature of Nageotte's theory is that

he insists upon the fundamental non-living character of all the connective-tissue substances.

In this connection, the work of Baitsell (1915-16) is most interesting. This worker observed the direct transformation of fibrin clot into connective-tissue fibres. Later, tissue cells wandered in, did not digest the fibres, but by their movements caused a division of the large bundles into smaller ones. These cells were rounded when they first appeared but later assumed the typical elongated spindle shape of fibroblast cells. There was no evidence of a later attempt of these cells to form new fibres. After further work (1917), Baitsell showed that the transformation of the fibrin clot was brought about by a fusion and consolidation of the fine elements of which it was composed. In 1921, he showed that the connective tissue in amphibian embryos is formed from a ground substance secreted by the embryonic cells before there is any syncytium of mesenchyme cells. This work tends to lend support to Nageotte's theory.

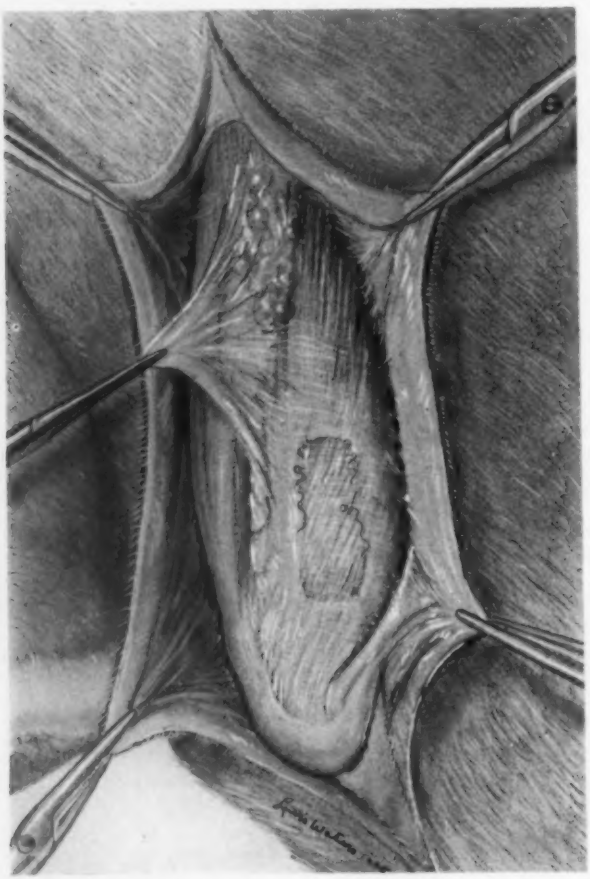

FIG. 2.—Piece of dead fascia from a cat grafted into the fascia lata of a dog. Four months after operation. The difference in thickness of the graft and surrounding fascia is not due to absorption, but to a difference in the original thickness of the structures in the two different species.

Nageotte (1919), described the transformation of dead inclosed protoplasm (dead cartilage cells) into collagenous substance. In 1920, he describes a similar "metamorphism" of the fibrinous network.

In 1917, Nageotte published his first experimental work on the use of "dead grafts." Since then, numerous papers have come out amplifying and enlarging his results and conclusions. He proceeds on the assumption that if connective-tissue substances are inert coagula formed from living cells, one would not expect grafts of dead tissues to act as foreign bodies and produce phagocytosis; the reaction to "dead" fibres should be the same as that to

"living" ones. The results of his experiments tend to give approval to his theory of the nature and origin of connective tissues. He transplanted pieces of tendon killed by alcohol or formalin and found that these attached themselves promptly to the connective apparatus of the living tendons which received them. The dead graft takes, and becomes adherent; soon it is impossible to determine its limits because the union between the dead and living tissue has effected itself to perfection. Microscopic examination likewise shows that the implanted tendon blends with the living tissue until no line of demarcation can be detected. After the dead protoplasm has been carried off by the migratory cells, new fibroblasts from the host flock into the persisting connective-tissue framework of the graft, and establish themselves in the place of the old inhabitants; circulation becomes established by the growing in of small vessels from the host, and in time it is actually impossible to tell that the graft had been dead when it was implanted. Nageotte calls this process the "reviviscence" of the graft; the dead graft has in fact become alive again!

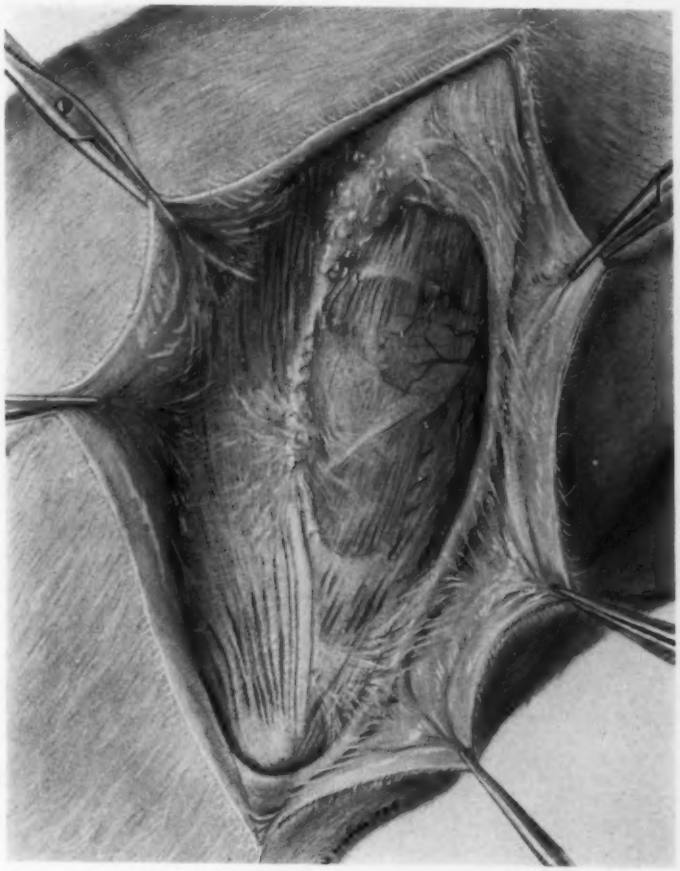

FIG. 3.—Dead fascia graft into the fascia lata of a dog. Drawing five months after operation.

When pieces of dead cartilage are transplanted into the ear of a rabbit the morphology of the graft makes impossible the invasion of fibroblasts from the living tissues. However, the graft remains in place, unaltered and adherent, but not encysted.

The only phagocytosis which one is able to observe is that which is necessary for the removal of dead protoplasm. The persistence of the grafts is

not simply an example of "aseptic tolerance." For in such cases, the foreign body is immediately surrounded by macrophages, and more slowly isolated by fibrous encystment: in a word, the so-called aseptic tolerance is accompanied by reactions which show clearly the intolerance of the tissues with regard to the foreign body.

Leriche and Policard object to the term "dead graft," claiming that in a graft, the continuity of the personal life of the transplant is preserved. Polettini and Bonnefon object to the term "reviviscence." However, these objections seem to be only matters of terminology.

Besides grafts of dead cartilage and tendon, Nageotte also grafted, with

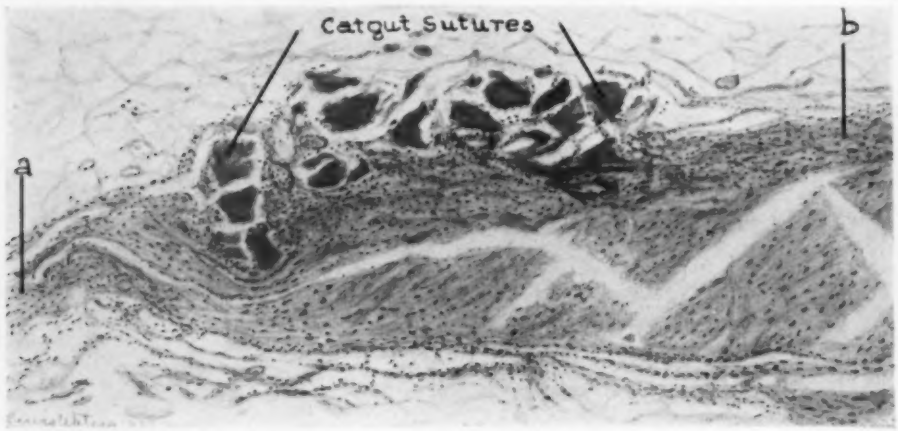

FIG. 4.—Microscopic drawing showing union of dead and living fascia. Four months after operation. a. Living fascia of host. b. Dead graft.

success, segments of dead arteries and nerves. Attempts at grafting dead arterial segments were made by Levin and Larkin in 1909, without success. They got thrombi, and necrosis and calcification of the implant. Carrell, in 1910, got similar results with dead arterial segments—the graft acted as a foreign body and the tissues of the host reacted by building a wall of connective tissue around it. Klotz, Permar, and Guthrie in 1923, reported the successful transplantation of devitalized, formaldehyde-fixed vessel segments, but remarked that there was a subsequent tendency to fusiform dilatation of the transplant due to loss of muscle tissue and elastic fibres.

Support is given to Nageotte's theories and results by the previous work of several authors, which tends to show that any graft is only relatively "alive." Bonnefon, after several years' researches (1913 *et seq.*) on living cornea grafts, opposes the hypothesis of the integral survival of grafts. He presents a series of histological facts which demonstrate the partial or total disintegration of the transplant and its regeneration by the graft carrier. The dead cells of the graft are replaced by living cells of the host, and the union of the graft to the host is effected by the growing in of fibroblasts from the host. Ribbert, Marchand, and Salzer had also previously expressed the view that in corneal grafts the cellular elements of the grafts disappear and

are replaced by others from the host. In similar vein, Villard, Tavernier, and Perrin, in 1911, expressed the view that vessels preserved a long time in the icebox do not live really, but that one grafts only their elastic skeleton, susceptible at all times of being invaded by cellular elements, which, derived from the graft carrier, furnish it a vitality sufficient to permit it to assure the continuity of the vessel on which it is implanted.

Some observations of Nageotte along the same line are most interesting. He draws a comparison between living and dead grafts and takes, for an example of comparison, a piece of living tendon graft. In such a graft three distinct phenomena occur: (1) the texture of the tissue introduced attaches

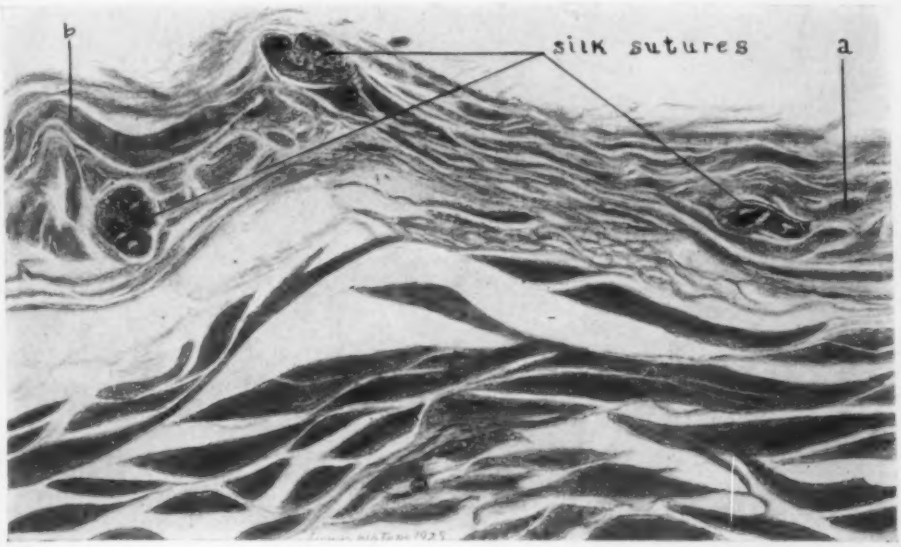

FIG. 5.—Microscopic drawing showing union of dead and living fascia. Four months after operation. a. Living fascia of host. b. Dead graft.

itself to that of the host; (2) a new vascular network is installed; and (3) the cells, for a moment altered, are rehabilitated in their former integrity. If a piece of dead tendon is inserted, what are the modifications of the process? Only the third phenomenon shows a variation: the dead cells are replaced by living cells. The final results are identical. Are there not all possible intermediaries between living and dead grafts? In living grafts kept in the icebox are not a large percentage of the cells dead?

Several workers have achieved excellent surgical results using the methods of Nageotte and Sencert. Nageotte and Sencert themselves, in 1918, reported the bridging of gaps of 3 or 4 cm. in tendons on the palmar surface of the wrist with tendons from a dog that had been preserved in alcohol for one month. Good result. Also Sencert, in 1918, reported the use of a dead nerve of a calf to bridge a gap of 2 cm. in a median nerve. The continuity of the nerve was established with no scar formation, as revealed by a subsequent operation. The report was made too early to be sure of the final outcome, but the result was encouraging, as there was beginning functional restoration. Walther

(1919), grafted 17 cm. of a young calf nerve preserved in alcohol in the radial nerve of a soldier. Good result. Auvray (1919), bridged a gap of 3 or 4 cm. in the tendon of a thumb with dead animal tendon. Good result. Dustin (1919), twice successfully grafted dead nerve of a calf in man. Jalifier (1920), implanted tendons taken from the leg of a calf or dog six to fifty days before. These were used to repair defects in the hand in five cases. Fairly good or very good functional results were reported. A few months later, Jalifier reported the repair of injured nerves with grafts of dead nerves in seventeen cases. Results doubtful. Busacca (1920), grafted dead nerves and tendons. Christophe (1923), successfully grafted an entire patella, with its quadriceps and patellar tendons, that had been preserved in 80 per cent. alcohol for three days, into the knee of a soldier who had lost his patella from a gunshot wound four months before. The grafted patella was obtained from another soldier who died from a head injury. The functional result was excellent, and a röntgenogram made four years after the operation showed a normal knee. Christophe also transplanted alcohol-fixed dead bone to repair defects in the radius and in the ulna with excellent results. Durand (1919), and Delorme (1919), observed and commented favorably upon the work of Nageotte and of Sencert. Regoli (1922), Regard (1923), and Weidenreich (1924), have successfully repeated the experimental work of all of these authors.

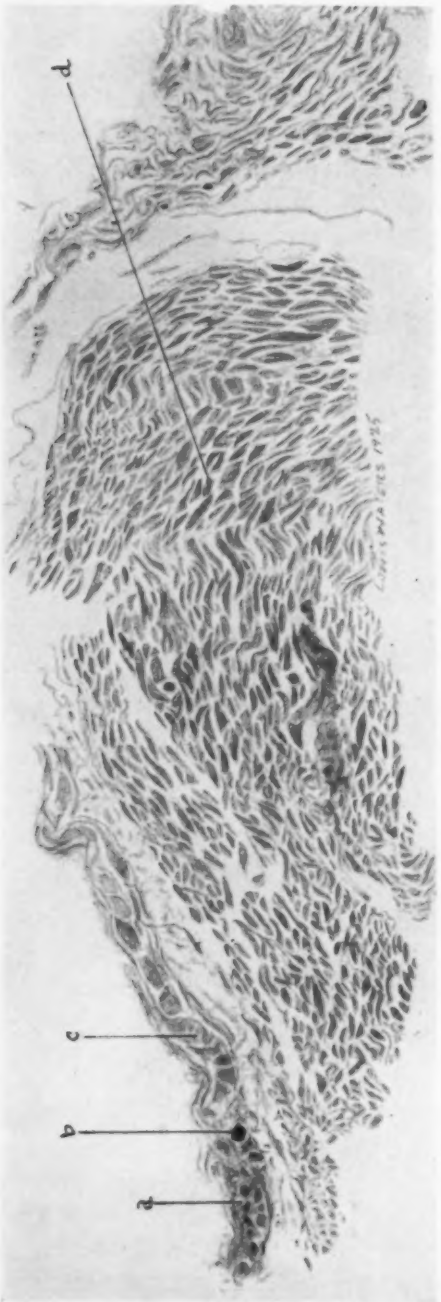

FIG. 6.—Low-power drawing of cross-section of dead fascia graft. Four months after operation. a. Living fascia of host. b. Silk suture. c. Dead graft. d. Muscle.

Nageotte and Sencert state that when a gap in a nerve is repaired by a

graft of dead nerve, the healing which takes place is entirely without scar formation or the formation of neuromata, which often occurs when a severed nerve is sutured. In this connection the recent work of Barthélemy (1920) is most interesting. This author calls attention to the fact that after nerves are injected with alcohol or osmic acid for neuralgia, the pain stops, but returns in about the same length of time as is required for nerve regeneration. He, therefore, did a series of experiments on dogs to determine just what happens when nerves are thus injected with alcohol or osmic acid. He found that after the injections, the nerves first degenerate and then regenerate. The regeneration always occurs entirely without scar formation or the formation

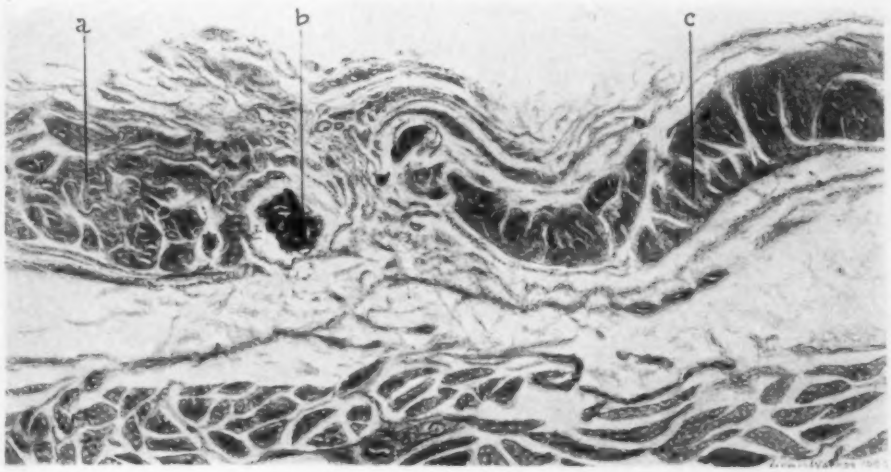

FIG. 7.—Enlarged drawing of a small portion of Fig. 6, showing point of union of dead and living fascia. a. Living fascia of host. b. Silk suture. c. Dead graft.

of neuromata. This tends to substantiate the work of Nageotte and Sencert.

The above-mentioned results have stimulated the author to undertake a series of experiments with a view to determining just what could be done with dead fascia grafts in the repair of hernias. We started out with a two-fold aim: First, to determine what becomes of dead grafts of fascia when transplanted among living tissues; and, secondly, if it should be found that the dead grafts survive, to determine whether hernias could be successfully repaired with them.

In order to solve the first part of our problem, namely to determine the fate of dead grafts when transplanted, we performed twenty-one operations on dogs and cats. The materials used in these operations were pieces of fascia that had been preserved in 70 per cent. alcohol for varying periods of time (three to seventy-five days). The fascia lata and the sheath of the rectus were the principal sources of the dead grafts. Some of the grafts had been previously taken from the same animal (autografts); others were taken from other animals of the same species (isografts); and still others were taken from a different species—grafted from cat to dog, or from dog to cat (zoografts). The usual method of procedure was to cut a rectangular

opening in either the sheath of the rectus or the fascia lata and to repair this defect with a piece of dead fascia cut to fit the opening. The thigh proved to be the site of choice for the operation, as the fascia lata is not adherent to the underlying muscle as is the case with the sheath of the rectus. The dead graft was sutured in place by continuous sutures of fine black silk. Catgut was tried but was found not to be as satisfactory as silk for holding the graft in place. The subcutaneous tissue and skin were then sutured over the emplaced graft.

These animals were sacrificed in from two to seven months after operation, and the grafts with the surrounding fascia removed for microscopic section. In a few cases in which the graft was too small to fit the fascial defect, the edge of the graft had pulled away from the edge of the fascia to which it had been sutured. However, in nearly all cases, the graft had remained in place and the living fibres had so intermingled with those of the dead tissue that it would not have been possible to tell where one stopped and the other began, except for the row of black silk sutures. Examples of this are shown in Figs. 1, 2 and 3. In no cases were there evidences of absorption of the grafts. Microscopically the same intermingling of fibres is seen (Figs. 4, 5, 6 and 7). Furthermore living cells can be seen to have wandered in among the dead fibres, so that the former dead graft is now, in effect, living tissue.

FIG. 8.—Suture of internal oblique muscle to Poupart's ligament in a dog, by the method of Gallie and Le Mesurier, but substituting dead strips of fascia lata for their "living sutures." Four months after operation.

From the foregoing, and the work of the other authors quoted above, it appears that dead fascia used as grafts can be counted upon to remain in place and to do the same work as the living grafts ordinarily used for the same purposes. Why then can not dead strips of fascia lata be used in the new operations of Gallie and Le Mesurier for hernia, instead of their "living sutures"? Would it not simplify their procedure a good deal to be able to take their suture material out of a jar in the operating room rather than to have to perform an additional operation in order to get this material? In order to try out this simpler procedure, we sutured the internal oblique muscle to Poupart's ligament in two dogs, using strips of dead fascia lata as suture material, and employing the technic advocated by Gallie and Le Mesurier. As pointed out by the author in a previous communication, the internal oblique muscle

forms a greater angle with Poupart's ligament in the dog than in man. Therefore, it requires more tension on the tissue to bring these two structures into apposition by suture in the dog than in man. In spite of this, and the use of strips of *dead* fascia as suture material, we got the firmest sort of dense fibrous union of the muscle to the ligament in both of our operations (see Fig. 8). In fact the union was much firmer and accompanied by much denser adhesions than that previously reported when silk or catgut was used as suture material.

We next undertook to produce large ventral hernias in dogs, and then to repair them by the use of large grafts of dead fascia. A ventral hernia is hard to produce in a dog, as any defect made in the abdominal wall tends to repair itself by an excessive growth of fibrous tissue. We early noted that when the external sheath of the rectus was removed for subsequent use as a dead graft, that subsequent operation or autopsy showed the defect to be repaired by a dense overgrowth of fibrous tissue much stronger than the original rectus sheath. We also learned by repeated attempts at hernia production that a wide excision of abdominal wall was necessary, and so came to employ the following procedure: Three or four inches of the rectus muscle on both sides were excised, including both the external and internal rectus sheaths. The peritoneum was opened with a large crucial incision, and left open. The subcutaneous tissue and skin were then sutured over this opening. The result was a large bulging ventral hernia.

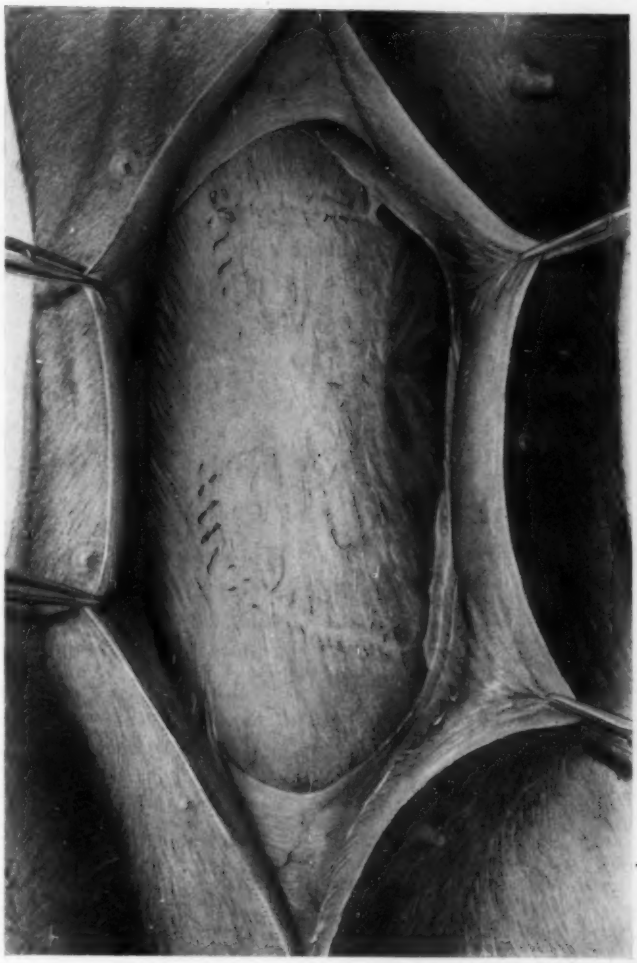

FIG. 9.—Repair of large ventral hernia in a dog with a piece of alcohol-preserved fascia lata of an ox. Five months after operation.

In a few weeks this hernia was repaired with a large piece of dead fascia. Various materials were tried, including the submucous coat of the pig's bladder, the pericardial sac of the ox, and the fascia lata of the ox. The last named material proved most satisfactory, as it is tougher and has practically no give to it. The operation was conducted in this manner: The skin was opened, and any excess fibrous tissue that had grown across the defect in the abdominal wall was removed, leaving only a very thin layer of subcutaneous tissue between skin and peritoneum. The sheath of the rectus, bordering the defect above and below, and the external oblique, bordering it on the sides, were then exposed. The graft of dead fascia was then placed so as to overlap the edges of the defect and sutured in place. Above and below it was sutured to the sheath of the rectus, and on the sides to the fascia of the external oblique muscle and the external oblique muscle itself. Fine black silk doubled was used as the suture material. The buttonhole stitch was tried, but the ordinary continuous suture proved better. The subcutaneous tissue and skin were then sutured over the graft. The dogs thus operated upon were sacrificed in from four to six months after operation. Figure 9 shows a typical result. The hernia was completely cured, and the dead and living fascia would have been indistinguishable, except for the line of suture.

In the foregoing experiments, fascia from several different species were transplanted into other species indiscriminately, and with no ill effect. Heteroplastic grafts took just as well as homoplastic ones. Other workers with dead grafts have had the same experience. It is well known that this is not true of living grafts. The possible explanation is that the preservation of the graft in alcohol or formalin eliminates the antagonistic action of foreign sera. Occasionally, however, certain dead heterogenous grafts appear to be toxic. Nageotte (1920) says that the tendon of the tail of the white rat or of the sewer rat used for suture of pieces of nerve in the dog, or transplanted into the eye of the rabbit, provokes a chronic inflammation which produces its destruction slowly without suppuration.

CONCLUSIONS

1. Grafts of dead fascia, preserved in alcohol, when transplanted among living connective tissues, remain intact and unite with the tissue of the host. After a period of a few months it is impossible to distinguish the living from the "dead."

2. The living and "dead" are likewise indistinguishable microscopically.

3. The suturing together of the internal oblique muscle and Poupart's ligament with strips of dead fascia in the dog results in the firmest type of fibrous union.

4. Large, experimentally produced, ventral hernias in the dog can be successfully repaired by the use of large grafts of dead fascia.

5. Dead fascia grafts may be homogenous or heterogenous.

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SKIN PLASTICS IN THE TREATMENT OF TRAUMATIC LESIONS OF THE HAND AND FOREARM*

By Henry H. M. Lyle, M.D.
of New York, N.Y.

The criterion of success in treating disabilities of the hand is the restoration of function. Prompt healing is an essential requirement in obtaining

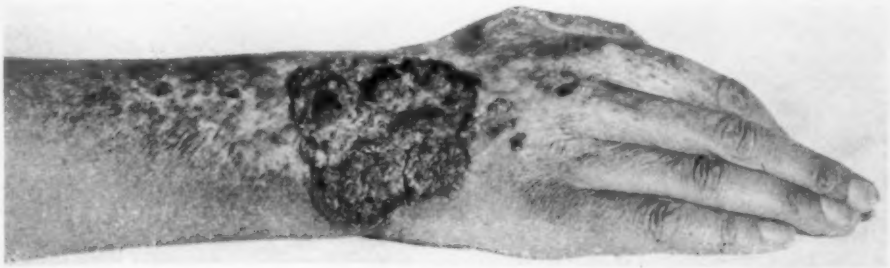

Fig. 1.—Illustrating the primary closure of wound by pedunculated flap and extensor tenoplasty. Epithelioma developing in the scar of an old burn. Patient refused amputation so an excision of the growth and axillary glands was performed.

early functional use, and it is our belief that much time is saved by the employment of suitable skin plastics.

Due to the extent or nature of the traumatic lesion, it may be unwise or impossible to immediately carry out an ideal closure. Under such circumstances we can reduce the probable duration, extent and severity of the disability by tissue transplantation. The desired closure can be obtained by a primary, or a secondary skin plastic. The object of the former is an immediate healing of the wound, of the latter a hastening of the healing by providing an epidermal covering.

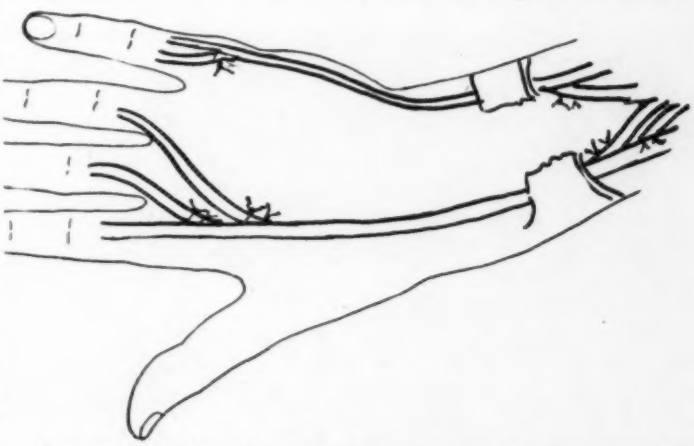

Fig. 2.—Illustrating the primary closure of wound by pedunculated flap and extensor tenoplasty. Diagram of extensor tenoplasty. All the soft structures were excised with the exception of the tendons of index finger and the inner slip of the little finger. The proximal and distal ends of the excised tendons were sutured as shown.

No two problems are exactly alike and we must be prepared to meet an

* Read before the New York Surgical Society, December 9, 1925.

endless variety of conditions. Skin plastics may be employed singly, in combination, or in series and as primary or secondary closures. We will not go into the details of the numerous plastic operations but direct attention

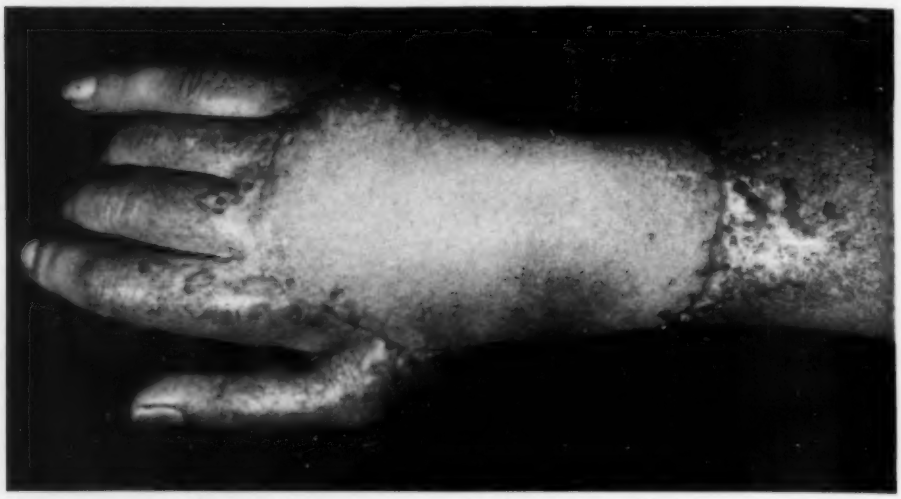

FIG. 3.—Illustrating the primary closure of wound by pedunculated flap and extensor tenoplasty. After the tenoplasty the excised area was immediately closed with a pedunculated flap from the abdomen. Note that it extends from the knuckles to two and one-half inches above the wrist. The patient has obtained a useful hand.

to the value of the early employment of certain procedures. Under the term skin plastic we include all tissue transferring procedures that are used in closing defects, epidermic grafts, full thickness grafts, sliding flaps, peduncu-

FIG. 4.—Illustrating secondary closure by Ollier-Thiersch grafts. Hemolytic streptococcus gangrene with extensive destruction of skin.

lated flaps from the immediate neighborhood, pedunculated flaps from a distance, and doubled-leafed flaps.

Skin Plastic Measures Employed with the Object of Obtaining a Primary Permanent Closure.—The ideal method is to perform a careful débridement and immediately cover the raw surface with a suitable flap. To do this we must have ideal conditions, the control of the patient from the time of the

accident, a good blood supply, and a probable aseptic field. This method is employed with advantage in partial and atypical traumatic amputations.

In moderate skin destruction without tendon exposure a full thickness graft can be used as a primary procedure. This type of graft is used with advantage in the palm and the fingers. The chance of success on a fresh

FIG. 5.—Illustrating secondary closure by Ollier-Thiersch grafts. Shows condition of arm 43 days later. The result after débridement, Carrel treatment and Ollier-Thiersch skin grafts. Contrast with Fig. 6.

surface is about 85 per cent. It is not to be used on granulating surfaces, a fresh clean bed is required.

In small defects where a moderate amount of contraction is of no importance an Ollier-Thiersch graft can be employed; on the other hand, if the

FIG. 6.—Illustrating the result of expectant treatment for burn. After eighteen months she is still unhealed, has a useless hand fixed in extension and a dorsal dislocation of the thumb. Much pain, disability and loss of time could have been saved by a prompt secondary skin graft.

skin defect is large and the tendons exposed, a pedunculated flap from a distance will be required. If the conditions are such that the latter cannot be obtained and the local tissues do not furnish enough material for the closure of the defect, an immediate partial permanent closure can be carried out. The exposed tendons are covered with a sliding flap or with a local pedunculated

flap, and the flap bed closed by an Ollier-Thiersch graft, the final revision of the wound being deferred to a later date.

Pedunculated flaps from a distance are indicated as a primary procedure

FIG. 7.—Illustrating the use of skin plastics in series. Eight days before admission patient's hand was caught in hot mangle. All structures were torn off exposing the metacarpals, and opening the metacarpo-phalangeal joint of the ring finger. Note absence of tendons, the exposed bone and the open fifth metacarpo-phalangeal joint with dislocation of finger. The wound is infected.

in the large skin defects with exposure of tendons where the surgeon has created the conditions. For example in defects left after the excision of tumors, contractures and X-ray burns. (Figs. 1, 2, 3.)

Secondary Closure by Ollier-Thiersch Grafts.—(Figs. 4, 5, 6.) This

FIG. 8.—Illustrating the use of skin plastics in series. Wound treated by the Carrel method and two weeks later closed with pedicle flap from abdomen. Failure due to erysipeloid infection. Twenty-four days later wound successfully closed with an Ollier-Thiersch graft. Note the small dark area of bone necrosis over the third metacarpal; the removal of this necrotic scale stirred up a second sharp erysipeloid inflammation and all operative work was postponed.

method finds its greatest usefulness in extensive destruction of skin, in large granulating areas, in burns, and ulcerations. These lesions are extremely common and as a class cause much suffering and disability. Unfortunately

only a small proportion of these sufferers receive the benefit of an early plastic covering. The object of the treatment is to sterilize the wound and provide

FIG. 9.—Illustrating the use of skin plastics in series. Three months later the Ollier-Thiersch graft was excised and replaced by a pedicle flap from the abdomen.

an epidermal covering. Thanks to Carrel we can almost guarantee the take of Ollier-Thiersch grafts. Prompt sterilization combined with epithelization of a granulating area prevents the excessive production of scar tissue, improves the nutrition of the part, hastens healing and provides the best defense against infection; and by allowing early functional use it minimizes the possibilities of future contractions. Compare the results in Figs. 4 and 5 with 6.

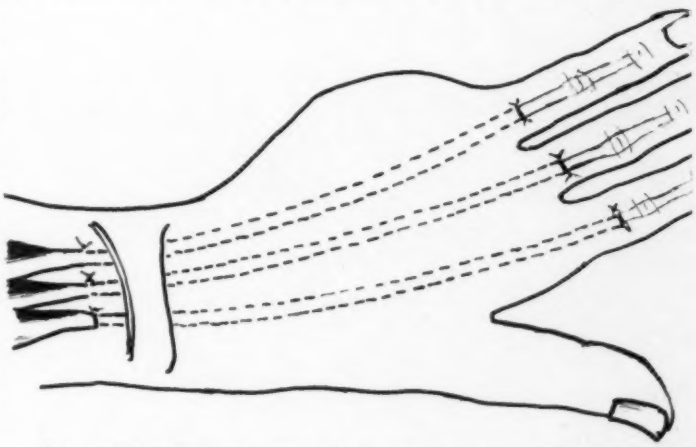

FIG. 10.—Illustrating the use of skin plastics in series. The proper bed for a tendon transplantation having been formed, a free transplantation of tendons from the long extensor of the foot was made into the hand. A transverse incision was made in the base of each finger and in the forearm above the flap and the latter then tunnelled. The grafted tendons were inserted through the tunnels and stitched to the stumps of the extensors in the fingers and in the arm. The ankylosed little finger being useless, was amputated.

The Use of Skin Plastics in Series (Figs. 7, 8, 9, 10, 11).—The object of this method is to obtain the physiological and anatomical advantages of an early temporary closure, so that further recon-

structive surgery can be carried out at a more opportune time. This method provides surgical insurance for future work. In the face of a recent infection it is unwise to attempt extensive reconstructive work, therefore, temporary Ollier-Thiersch grafts are applied and later when the nutrition has improved and the danger of infection has passed the temporary graft is excised and a pedunculated flap or other suitable plastic covering substituted. When the nutrition of the new graft is assured, we are in a safe position to carry out

FIG. 11.—Illustrating the use of skin plastics in series. Shows the grasp. Fig. 9 shows extension and separation of fingers. The patient has a strong useful hand.

any desired reconstructive plan, *e.g.*, the formation of new digits, free tendon grafting, arthroplasties, bone grafts, etc.

CONCLUSIONS

1. The prompt sterilization and early application of Ollier-Thiersch grafts to granulating areas, burns, ulcer, etc., will save the patient much time, suffering and disability.

2. The possibilities of reconstructive surgery in unfavorable cases can be greatly extended by the use of plastics in series.

3. These simple procedures should be employed much more frequently than they have been in the past.

TRANSACTIONS
OF THE
NEW YORK SURGICAL SOCIETY

Stated Meeting Held December 9, 1925

The President, Dr. Walton Martin, in the Chair

COMPLETE CONGENITAL OBSTRUCTION OF THE DUODENUM, DUODENO-JEJUNOSTOMY AT NINE DAYS

Dr. Richard W. Bolling presented a female baby born on October 13 on the service of Doctor Dorman at the Woman's Hospital. Birth-weight was six younds and nine ounces and she appeared to be a normal infant. As soon as nursing was begun, vomiting was noted and the vomiting persisted, though not after each feeding. Typical meconium stools appeared and the character of the stools did not change. Dr. Harold Mixsell made a diagnosis of probable congenital anomaly and a röntgenogram made on the eighth day showed a complete obstruction of duodenum, with great dilatation of proximal segment. Dr. Downes saw baby in consultation, he advised operation and referred infant to Babies' Hospital, where Dr. Bolling operated on ninth day. At the time of operation the baby weighed five pounds. The stomach was greatly dilated, the pylorus appeared normal and the duodenum was dilated to about two-thirds the size of the stomach. The colon was closely applied to the mesial surface of the dilated duodenum. No attempt was made to ascertain the exact cause of obstruction.

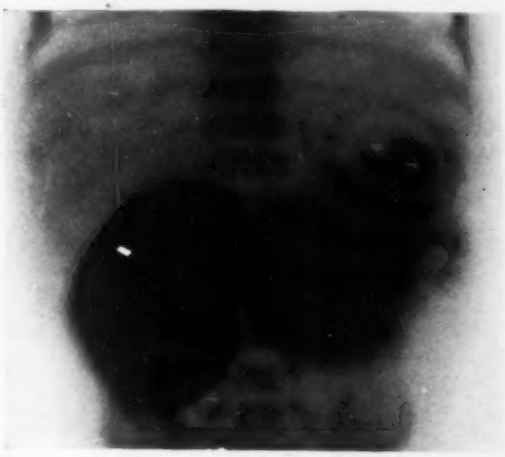

Fig. 1.—Complete congenital obstruction of the duodenum. Six hours after opaque meal.

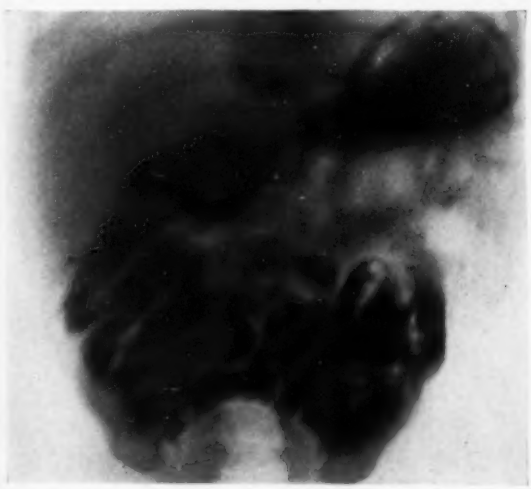

Fig. 2.—Complete congenital obstruction of the duodenum. Six weeks after duodeno-jejunostomy. A few minutes after opaque meal.

An anastomosis between the dilated duodenum and the jejunum, about ten centimetres below the flexure, anterior to the colon, was effected. Jejunum was collapsed, its diameter somewhat less than that of lead pencil.

Convalescence was stormy for several days and complicated by infection of the wound. The stump of the umbilical cord was present at the time of operation and did not separate until the fourteenth day. Milk stools were

noted on the second post-operative day and there has been no vomiting since that time. Gain in weight has been slow but progressive. The wound is soundly healed. (Fig. 2.)

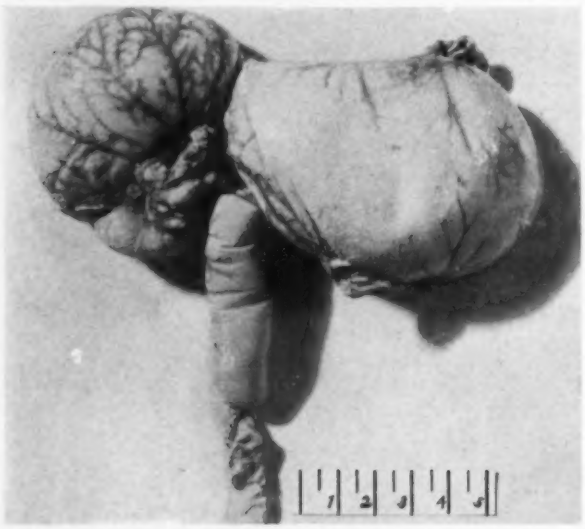

FIG. 3.—Complete congenital obstruction of the duodenum. Specimen removed at autopsy twenty-three days after gastro-enterostomy.

Duodeno-jejunostomy seems to be the operation of choice in this condition and the operation anterior to the colon was chosen, as it seemed simpler under the circumstances. A similar procedure was carried out by Doctor Ernst, of Copenhagen, in 1914.

To illustrate the anatomical condition, Doctor Bolling presented a specimen removed twenty-three days after operation in a similar case. (Fig. 3.) In this instance a posterior gastro-enterostomy was done. The obstruction was due to a diaphragm the site of which is indicated in the drawing. (Fig. 4.) Infection of the wound was the only serious post-operative complication and was the direct cause of death in the fatal case. In each instance the infection was to be attributed to an unhealed and infected umbilicus.

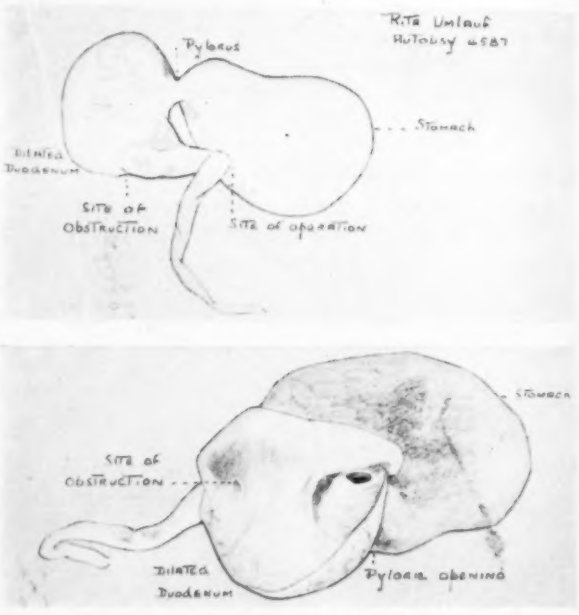

FIG. 4.—Complete congenital obstruction of the duodenum. Drawing indicating site of diaphragm causing obstruction.

DR. EDWARD W. PETERSON said that he had taken care of an infant only a few days old with a congenital obstruction of the duodenum similar to Doctor Bolling's case. The diaphragm in the duodenum, while not complete, was sufficient to cause obstruction of the bowel. An operation on the plan of the Horsley pyloroplasty relieved the obstruction satisfactorily. Unfortunately, the child was in such poor condition at the time of operation that death followed a few hours later.

CHRONIC IRREDUCIBLE INTUSSUSCEPTION, IN TWELVE MONTHS' INFANT; RESECTION

Dr. Richard W. Bolling presented a female baby, who was admitted to the Babies' Hospital, June 17, 1925, having been referred to the hospital by Doctor McLean. At the time of admission the baby was ten days less than twelve months old. Two weeks before admission the child became irritable, vomited, and passed dark blood and mucus per rectum, and the abdomen became distended. The child remained irritable, but the vomiting ceased and the distention gradually became less. Mucus was passed but no blood. For several days before admission stools were normal. There had been considerable loss in weight.

Fig. 5.—Chronic irreducible intussusception. Opaque clysma.

On examination the child did not appear acutely ill, was apathetic and somewhat dehydrated. There was no suggestion of distention. In the right upper abdomen and extending across the midline was an oblong rounded mass. No intermittent contractions were made out. A diagnosis of chronic intussusception was made and this was confirmed by means of a bismuth enema. (Fig. 5.)

Operation was carried out on the following day and an ileocæcal intussus-

Fig. 6.—Chronic irreducible intussusception. Specimen removed.

ception extending into the splenic flexure was found. The small intestine was dilated and its walls greatly thickened. Reduction of the intussusception was easily carried out until the upper portion of the ascending colon was reached, when further reduction was impossible. A resection of the distal

ileum, the cæcum and the ascending colon, followed by axial anastomosis of the ileum and transverse colon, was carried out. (Fig. 6.) Convalescence was fairly smooth and the wound healed without incident.

In an experience of about one hundred cases of intussusception in infancy, he had seen only two instances of chronic invagination.

OVARIAN CYST FREE IN PERITONEAL CAVITY OF THREE MONTHS' OLD INFANT

Dr. Richard W. Bolling presented a female baby, admitted to the Babies' Hospital, April 15, 1925. The history was that of vomiting almost since birth, with loss of weight for six weeks. The infant appeared in wretched condition, emaciated and dehydrated. In the right lower quadrant there was a rounded elastic mass somewhat larger than a golf ball. This was freely movable and could be displaced into each quadrant of the abdomen.

Fig. 7.—Ovarian cyst free in peritoneal cavity of three months' infant.

At operation the mass was easily delivered into the wound and then rolled off to one side of the table, having no attachment whatever. (Fig. 7.) The uterus appeared normal and a normal tube and ovary were on the left side. The tube and ovary on the right side were absent, there being only a smooth short stump of the tube remaining. Spontaneous separation as a result of torsion of an ovarian cyst seems the probable explanation. Microscopic examination confirmed the diagnosis of multilocular ovarian cyst.

The immediate post-operative recovery was smooth, but the child subsequently developed a severe furunculosis which greatly prolonged its stay in the hospital.

Dr. Robert T. Morris reported a similar case in an adult in whom the cyst was discovered, by pathological examination, to be parovarian in origin. He asked whether a pathological examination had verified the ovarian orifice of this cyst.

Doctor Bolling, in closing the discussion, said that the pathological examination in this case had proven the cyst to be ovarian.

CARCINOMA OF THE STOMACH. RESECTION-IMPLANTATION OF DUODENUM INTO PANCREAS

Dr. Charles Gordon Heyd presented a man, forty-three years of age, who entered the Post-graduate Hospital, September 29, 1925, complaining of cramp-like sensations, localized in the epigastrium, appearing two to three

hours after eating. This pain has been relieved occasionally, but not uniformly, by a glass of hot water. There has been no nausea or vomiting. The patient has never had any jaundice with the present complaint but has observed tarry stools on a few occasions. His best weight has been 160 pounds. His present weight is 135 pounds. Coincident with the loss of weight patient noticed a feeling of weakness, with increasing dyspnœa on exertion.

On physical examination of the patient nothing noteworthy was determined. On X-ray examination an irregularity was seen on the mesial surface of stomach, at the distal portion of the pylorus, with a narrow canalization through this area.

At operation, October 7, 1925, an infiltrating carcinoma was found, involving the distal third of stomach. Protruding through a patulous pylorus was an annular carcinomatous ulcer with involvement of the lymph-glands along the lesser curvature and between duodenum and pancreas. The lymph-glands along the lesser curvature seemed hyperplastic and inflammatory, whereas the glands bneath the pylorus and duodenum were undoubtedly metastatic carcinoma. The liver was not involved. A subtotal resection of the stomach, pylorus and first portion of the duodenum was carried out, after which a Billroth No. 2 operation was performed. After the excision of the duodenum there was insufficient duodenal tissue to make a complete inversion. The lumen was obliterated by oversewing with No. 2 chromic catgut and no attempt was made to invert the stump. The duodenum was elevated, turned over and to the right and sutured firmly in place on the anterior surface of the pancreas. In other words, the mucosa of the duodenal stump was in direct contact with the peritoneum of the pancreas. This made a very neat and hermetic closure and the subsequent post-operative course demonstrated the efficiency of the duodenal blocking.

The tissue removed was a piece of stomach, 120 x 75 mm. The diameter of the ulcerated area was 75 x 80 mm. The periphery of the ulcer presented a projecting margin rising about 15 mm. above the general surface and from 8 to 12 mm. in width. The ulcerated surface was finely granular and red without any evidence of mucous membrane. The wall of the stomach showed a marked thickening of the submucous layer which was well defined from the muscular coat. In the large omentum there were several lymph-nodes which were firm.

Section of the floor of the ulcer showed dense fibrous tissue richly infiltrated by irregularly branching gland tubules. These were lined by highly irregular columnar epithelium. They extended to the muscle coat. Sections of the lymph-nodes in the omentum showed extensive replacement of the structure by neoplasm in some of these. Another lymph-node showed only a very small collection of epithelial cells. Still another lymph-node showed only inflammatory reaction. Pathological diagnosis: Large ulcerated adenocarcinoma of the pyloric end of the stomach with extension to the lymph-nodes in the omentum.

The patient had a rather strenuous post-operative course but was afebrile at the end of the fifth day. On the ninth day he developed a temperature of 103.5°, which fell to 101° next morning, and for a week he continued with a temperature of 101°. On the sixteenth day post-operatively he developed a temperature of 103° and at the same time an area of localized dulness below the right scapula. On paracentesis about fifteen c.c. of dark brown, foul-smelling fluid was obtained, which on culture proved to be streptococci and

a Gram-positive cocci forming green colonies on plates, probably pneumococci. X-ray examination on this date showed partial lung retraction with a fluid level well above the middle of the right pulmonic field, evidently a localized encapsulated partial hydropneumothorax. October 27, on the seventeenth day post-operative, Doctor Moolten did a rib resection and excised a portion of the seventh rib and drained a localized empyema, evidently secondary to a subpleural abscess probably of embolic origin. In the meantime, the gastric wound healed thoroughly and the patient proceeded to an uneventful convalescence and was discharged from the hospital November 10, thirty-three days after his original gastric operation.

The interesting feature of this case was the necessity of resecting the tumor from the anterior surface of the pancreas, together with a loss of so much duodenal tube as to make the ideal inversion closure of the duodenum impossible. Recourse was had to implanting the non-inverted duodenal stump into the anterior surface of the pancreas, with very excellent result.

WERTHEIM OPERATION FOR MALIGNANT ADENOMA OF CORPUS UTERI

Dr. Charles Gordon Heyd presented a woman, aged fifty-one, who entered the New York Post-graduate Hospital, November 12, 1925, complaining of bleeding from the vagina. The duration of her complaint was roughly three years. So far as the patient could recall her last regular menstrual period was three years ago. One month later she began to flow and continued to bleed for four weeks. The bleeding then stopped for two weeks and was resumed again two weeks longer. This intermittent bleeding of a week or ten days, followed by a clear interval of similar length, continued more or less constantly until about two months ago, when the patient began to have daily bleeding. The patient believes she has lost about ten pounds in weight. The patient had one child about twenty years ago; normal delivery, without any noteworthy complications. On vaginal examination the perineum was intact: the uterus was well forward and but slightly enlarged over the normal for her age.

November 13, a diagnostic curettage was done. The curette brought away a number of adenomatous appearing particles from the interior of the uterus. In the gross the curettings consisted of about five c.c. of material and contained numerous flakes of a faint light pink tissue. On fixed and stained specimens the pathological report showed that there was a large amount of endometrium in which the glands were giant in size, irregularly branched and lined by two or more layers of somewhat irregular columnar cells. In some places the lining was partly exfoliated. The stroma between the glands was not very abundant and there was a moderate excess of round cells and polymorphonuclear leucocytes in it. The epithelial lining of the glands showed only occasional mitotic division fitures. The sections do not include myometrium and it was therefore impossible to judge as to the nature of the process in the deeper tissue. These curettings, which were evidently superficial in origin, showed an enormous adenomatous hyperplasia which at this age was very suggestive of malignant neoplasm. In the absence of fibroids such a hyperplasia of the endometrium was in itself highly suspicious. Diagnosis—a very marked irregular adenomatous hyperplasia of the endometrium.

He felt reasonably certain from a clinical standpoint that he was dealing with a malignancy of the body of the uterus and along the type of malignant adenoma. Accordingly, November 18 a Wertheim operation was performed.

Very little technical difficulty was encountered. The ureters were exposed, kept constantly in sight, and all of the parametrial tissue was included with the upper portion of the vagina. The histological examination of the polypoid mass from the interior of the uterus showed that it consisted of highly irregular branching glands of the endometrium. These glands were lined by one or two layers of epithelial cells which were irregular in size and shape. Between the epithelial cells one found many round cells and polymorphonuclear leucocytes. Mitotic division figures were not very abundant. These gland alveoli were in close contact with muscle and in some places prolongations extended into the muscle bundles. The picture was not that of a fully developed carcinoma, but the lesion was that of a malignant adenoma and to be regarded as especially dangerous at this age.

Dr. William Crawford White stated that a few years ago he did some work on curettage scrapings. It had been found necessary to have the history of the patient as well as the gross and microscopic examination of the curettings in order to make a diagnosis. One may see the same microscopic picture in three cases—and find gross evidence in the removed uterus later; find no gross but microscopic evidence in the next; and find neither gross nor microscopic evidence in the third. In the last it might be possible that a very early carcinoma was removed; but even if this is not admitted, in a suspicious case at the cancer age we are more justified in doing a hysterectomy than not doing one.

HYDATID CYST OF THE LIVER INVOLVING BOTH LOBES

Dr. Charles Gordon Heyd presented an Italian woman, twenty-six years of age, residing in the United States for the last twelve years, who entered the New York Post-graduate Hospital, November 2, 1924, complaining of pain in the epigastrium, eructations of gas, vomiting. X-ray examination at that time revealed a duodenal ulcer and the patient was placed upon a Sippy diet for two months. Three months later she had a reappearance of her symptoms and the same burning sensation that she had before entering the hospital. X-ray examination in February, 1925, showed that the röntgenological evidences of duodenal ulcer were much less than in the previous November and the Röntgen diagnosis at this time (February) was duodenal irritation rather than ulcer. In June, 1925, the patient returned to the hospital with marked tenderness in the right upper quadrant and a liver apparently extending about seven cm. below the costal margin. The patient entered the Post-graduate Hospital for operation, September 30, 1925, with the provisional diagnosis of tumor of the liver. October 1, a laparotomy revealed an hydatid cyst of the liver situated above the falciform ligament and involving both the right and left lobes of the liver. There were apparently two separate and distinct cysts, each twelve cm. in diameter, with the loss of about two-thirds of the substance of each lobe of the liver. On the superior surface of the left lobe-cyst were a number of daughter cysts which had broken into the peritoneal cavity. The gall-bladder had lost its color and exhibited glandular hyperplasia. The appendix was chronically infected, distorted, and contained fecoliths.

The abdomen was opened by a superior right rectus incision: the falciform ligament was split longitudinally which made a right and left flap. These were brought downward and outward on either side and sutured to the

anterior abdominal wall which, together with the round ligament of the liver, made a complete diaphragm between the stomach and liver. Below this diaphragm the abdominal wound was closed. Above the diaphragm the abdominal wound was left open and iodoform gauze was inserted to the extreme right lobe of liver and to the extreme left lobe of liver for the purpose of creating adhesions between liver and anterior abdominal wall. At the end of forty-eight hours with an actual cautery through this upper aperture, the cysts were opened and probably fifty cysts of various sizes evacuated, since which time the sinus has been kept open and the patient has intermittently discharged small daughter cysts. Within the last two weeks the sinus has contracted very markedly and there has been no discharge of cysts.

The interesting feature in this case is the fact that the hydatid cyst involved both lobes of the liver.

Dr. Henry W. Cave said that there is at the present time on the Second Surgical Division of the Roosevelt Hospital a young Italian man, twenty-four years of age, who had right upper quadrant pains for a period of about six months. He had been in this country for two months. The physical examination was negative except for a slight icteric tint of scleræ. X-ray examinations revealed a sausage-shaped lobulated calcified area in the right lobe of the liver well oustide of the gall-bladder shadow. It showed also distended gall-bladder and distorted duodenal cap. A pre-operative diagnosis was made of the calcified cyst of the right lobe of the liver, with chronic cholecystitis and peripyloric adhesions.

The operation revealed a good-sized right lobe of the liver, well up under the dome of the diaphragm. The liver was brought down and to the right side, it being then fairly easy dislocated into the wound. The cyst was enucleated in its entirety. The cyst wound was thick and firm. It was really with ease enucleated. There was surprisingly little bleeding from the bed of the cyst in the liver. However, it was thought advisable to insert some gauze packing into this dead space of the liver substance.

The gall-bladder was not disturbed, it was thought they had done enough. Numerous peripyloric adhesions were found, some of which were divided. The cyst upon opening was found to be filled with smaller daughter cysts.

It has been sixteen days since this man was operated upon and except for three or four stormy days immediately following the operation, he is making an uneventful recovery.

Dr. Alexis V. Moschcowitz said that about one year ago he had occasion to operate on a case of multiple hydatid cyst of the liver as well as of the gastro-hepatic omentum which had caused such obstructive symptoms of the pylorus that a tentative diagnosis of carcinoma of the stomach was made. Whenever he has such a case of hydatid cyst and the operation is not too hazardous, he attempts the removal *in toto* of the mother cyst. In view of the continuous discharge of daughter cysts in the case of Doctor Heyd the last one only four days ago, Doctor Moschcowitz is very much afraid that

the secondary operation for the removal of the mother cyst will eventually become necessary.

RAPID FORMATION OF GALL-STONES

DR. CHARLES GORDON HEYD presented a man, thirty-four years of age, who entered the New York Post-graduate Hospital, June 3, 1925, complaining of pain in the upper abdomen. Three years ago he was operated upon at Bellevue Hospital for gangrenous ruptured appendix. A year later he was operated upon at the Polyclinic Hospital for post-operative incisional hernia. For several years he has had recurrent attacks of pain in the epigastrium. The pain was periodical and recurred after each meal. May 23, 1925, an X-ray examination at Bellevue Hospital showed no defect of gastric outline but a deformity near the first portion of the duodenum with the röntgenological diagnosis of ulcer of the first portion of the duodenum. June 4, 1925, he was operated upon at the Post-graduate Hospital and on the anterior superior border of the duodenum two cm. from pyloric ring a duodenal ulcer was found with about fifty per cent. of pyloric obstruction. In the area of the appendectomy were numerous omental and intestinal adhesions. The gall-bladder at this time was of normal color, was palpated carefully and there were no calculi present. There were, however, a few fine, non-inflammatory adhesions between the hepatic flexure and the gall-bladder. There was no enlargement of any of the lymph-glands in Calot's triangle and the common duct was negative. A typical posterior gastro-enterostomy was performed and the abdomen closed without drainage. The patient made an uneventful convalescence and was discharged thirteen days after his operation. One month later, on the 16th of July, or forty-three days post-operative, the patient had his first attack of pain in the region of the gall-bladder. He described it as a dull ache, which lasted about eight hours. He took a bottle of magnesia that night and the pain disappeared. He was then entirely free from symptoms for three weeks, after which he again had another attack of pain which lasted eight hours. The pain came on suddenly and disappeared as quickly as it came. About three weeks later he had a third attack. All of the attacks came on at night. The intervals between attacks, however, were becoming shorter, the last two attacks coming on with an interval of four days. On Tuesday, October 13, 132 days after operation, the reporter saw the patient in his office and the man had all the clinical signs of an acute cholecystitis. There was marked tenderness and spasm in the right upper quadrant, with a temperature of 100°. November 13, a second laparotomy revealed a gall-bladder markedly contracted, the walls being about one-quarter of an inch in thickness, markedly reddened, and extremely hard. A portion of the omentum and hepatic flexure was firmly adherent to the gall-bladder. The gall-bladder contained two calculi, 1.5 cm. in diameter, made up of a number of small stones firmly glued together after the fashion of a blackberry. In addition, there were about twenty smaller sized stones. All the calculi were of a bright yellow color. There was very little bile in the gall-bladder and about midway there was a raised ridge dividing the gall-bladder into two compartments. The cystic duct was surrounded by a considerable zone of inflammatory tissue and the common duct was negative. On opening the gall-bladder a gangrenous area about one-half inch in diameter, was found near the fundus on the inferior surface. An atypical cholecystectomy was performed, the gall-bladder was bisected from fundus to cystic duct and the

mucous membrane completely enucleated, leaving the serosal investment of the gall-bladder *in situ*. A rubber tube was sutured into the remainder of gall-bladder and the cut edges brought together with No. 2 chromic catgut over the rubber tube much after the fashion of a primary cholecystotomy. The abdominal wound healed rapidly and biliary discharge ceased on the sixth day and patient left the hospital at the end of two weeks.

The interesting features of this case appear to be as follows: At his operation on the third of June he had to all intents and purposes an apparently normal gall-bladder and a simple posterior gastro-enterostomy was performed. The patient left the hospital thirteen days after operation and one month later was complaining of an entirely different group of symptoms consisting of pain in the region of the gall-bladder, with strong predilection for nocturnal occurrence, and at the end of six weeks from the time he left the hospital was having attacks in every way typical of gall-bladder colic. In other words, a clinical picture of cholelithiasis, fifty-five days after his first operation. Doctor Heyd, being unwilling to concede a possible infection of the gall-bladder, treated him symptomatically throughout September and a portion of October. When he was seen at the termination of an attack November 11, 130 days after his operation, there could be then no question as to the diagnosis of cholecystitis. At operation there were found two calculi of sufficient size to warrant the assumption that they could not possibly have been overlooked at the previous operation. It would seem that the mechanism for the production of these calculi was an infectious embolus from the gastro-enterostomy with hepatic infarct, later an infection of the liver and a sequential lymphangitis, with secondary infection of the gall-bladder and calculi formation. The composition of the gall-stones of cholesterol with some slight degree of calcium and bile pigment suggests the ease with which they could reform. The gangrenous process in the gall-bladder also speaks for the intensity and rapidity of the cholecystitis. It would seem that the belief is warranted that formation of gall-stones can occur in a much less time than has heretofore been supposed. In a paper in the *Journal of the A. M. A.*, November, 1923, Angus L. Cannon reported a case of chronic cholecystitis with drainage, and eighty-six days post-operative a secondary operation revealed thirty-eight irregular calculi, consisting of cholesterol, calcium and bile pigment. It is interesting also to note that at the second operation on November 13, there was no visible residue of his previous duodenal ulcer. The most that they could find was a small point about three mm. in diameter, which had a slightly bluish tinge when the duodenum was put on tension so as to render it anæmic.

Dr. Franz J. A. Torek said that it was very difficult to determine how long ago these gall-stones originated. The fact that no stones could be felt at the previous operation was not sufficient proof that none were present. He had more than once found the following condition: In a given gall-stone case he may have felt one or two stones, but in spite of careful palpation could not make out any others. On opening the excised gall-bladder, however, a number of very small stones would be found in folds of the mucosa in addition to those that were felt through the walls of the gall-bladder previous to its removal. In the case of calculi of one or two millimetres in diameter he believed that palpating skill was not always reliable.

Dr. Edwin Beer said that there was no doubt that pathological studies as well as experimental studies showed that stones could form within less

than six weeks in the biliary or urinary tract. Primary, non-inflammatory stones of a pure cholesterin structure—as this was said to be in Doctor Heyd's case, had, however, never been reported as far as the speaker knew the literature, precipitation stones apparently being quite different from stones which are of an inflammatory origin.

Dr. Joseph Wiener remarked that it had been shown experimentally that gall-stones can be formed in forty-eight hours by annoying animals. A squirrel in a cage was annoyed for hours at a time and it was found that stones would form in a few days. So that it is not far fetched to deduce that gall-stones can be formed in the human gall-bladder in much less than ninety days.

PLASTIC FOR EFFECTS OF EXTENSIVE BURNS OF THE FOREARM AND WRIST

Dr. H. H. M. Lyle presented two patients, a man and a woman, to contrast the methods of treatment of burns. The woman, at the end of eighteen months, after much pain and suffering, has an unsightly and useless hand with a complete posterior dislocation of the thumb and unhealed nutritional ulcers. The man, with an extensive lesion reaching from the palm to the shoulder, was healed in forty-three days. The method of treatment in his case was prompt sterilization of the ulcerating area and the appliance of Ollier-Thiersch grafts. He has a useful arm and hand and is back at work. They had expected that they might have to excise some of the Ollier-Thiersch graft and replace it with a pedunculated flap—but this has been unnecessary as the prompt covering of the ulcerating area with the graft has greatly reduced the amount of cicatrical tissue.

The method of treatment in the woman was exactly the reverse, the burns were treated in the usual way with ointments, etc.; and when it was discovered that keloid formations were becoming excessive, the tissues were further insulted and devitalized by radium. What was the result? The poor woman's hand and arm became incased in the grip of a vice-like cicatrical contraction, which seemed to have taken malignant joy in squeezing the nutrition out of the arm.

It was necessary to excise the encasing cicatrical tissue for more than three-fourths of the diameter of the arm and from the elbow to the second joint on the thumb. The dorsal dislocation of the thumb had also to be corrected. The patient now has a useful functionating hand, with good prehensile action of the thumb, strong grasp, and complete fist.

FREE TENDON GRAFTS FOR LOSS OF THE EXTENSOR TENDONS OF THE HAND

Doctor Lyle presented a third patient to show the value of skin plastics used in series. In June, 1924, this patient had all the soft structures of the back of the hand, including the extensor tendons torn away. Eight days after the accident he entered Doctor Lyle's service at St. Luke's Hospital. The wound was infected. The skin of the dorsum was absent, there were no tendons, the metacarpals were bare. The fifth metacarpo-phalangeal joint was open and the finger dislocated. The wound was débrided and treated by the Carrel method. At the end of three weeks a pedicle flap from the abdomen was applied to the back of the hand. Failure due to an erysipeloid infection. The flap was cut away and the Carrel method started again. In

September, the area was covered with an Ollier-Thiersch graft. The wound healed completely with the exception of a very small area over the third metacarpal. In October a scale-like bone was removed, and this was followed by a second erysipeloid flare-up. By the end of two weeks the wound was closed. In January, the Ollier-Thiersch graft was excised and a pedicle flap from the abdomen was sutured in place. In March, a free transplantation of the tendons from the long extensor of the foot into those of the back of the hand was made.

The remaining portion of the extensor tendons were exposed in the fingers and in the arm above the flap, the flap was then tunnelled and the tendons from the foot inserted and sutured. The functional result is very satisfactory. The grasp, and the extension of the fingers is notable. He is now earning his own living and has a useful functionating hand.

A PLEA FOR EARLY AND MORE FREQUENT USE OF SKIN PLASTIC IN THE TREATMENT OF TRAUMATIC LESIONS OF THE HAND AND FOREARM

Dr. Henry H. M. Lyle read a paper with the above title, for which see page 537.

Stated Meeting Held January 13, 1926

The President, Dr. Walton Martin, in the Chair

TRAUMATIC BONE SARCOMA

Dr. William B. Coley presented the following cases as definite examples of acute traumatic malignancy, in which the history is so clear and positive that it leaves no reasonable doubt that the trauma was an important causative factor:

Case I. *Sarcoma of Occiput.*—W. B., male, twenty-eight years old, was admitted to the Hospital for Ruptured and Crippled, October 4, 1925, to the service of Dr. J. P. Hoguet. The patient gave a very lucid and connected account of an injury and the subsequent developments. He was employed as receiving clerk in the warehouse of a big department store. On the morning of June 22, 1925, while checking alone the invoice numbers of some crated goods which had just been unloaded on the sidewalk in front of the store, he was struck on the head by a falling piece of furniture. The patient did not fall to the ground but was dazed for a moment. The scalp was not broken but a small hæmatoma formed on the upper occipital region. He continued with his work, but during the remainder of the day he felt nauseated; he did not vomit. Finally he became so uncomfortable that he left for home about two hours before the usual quitting time. He went to bed at 8 o'clock that evening, instead of at his customary retiring hour, between 10 and 11 o'clock. He returned to work on the following morning, but suffered from a disagreeable headache throughout the entire day. The same situation continued for three days when, June 25, he reported his condition to his superintendent, who advised him to consult the company physician. This he did. The swelling on the back of his head gradually increased until it had reached the size of half a hen's egg. The physician advised an incision, which he proceeded to do but did not complete on account of lack of instruments. He advised the patient to return on the following day in order that he might

open up the swelling. On the following day, however, he referred the patient to the physician of the Insurance Company, who advised him to return home and bathe the part with hot water. The swelling decreased in size so that at the end of fifteen days it had nearly subsided. His headaches, however, continued intermittently. About two weeks later, the injured area began to increase in size, and in the last week of September, while seated at a table, everything went black before his eyes and he could not see for about twenty minutes. His headache returned, and he became nauseated but did not vomit. He was unable to report for work on the following day. The next day he returned to the Insurance Company physician who had some X-ray pictures taken and then referred the patient to Dr. Walter Jones. Doctor Jones incised the swollen area while the patient was in his office, but on account of the severe hemorrhage, applied a dressing and sent him to the Hospital for Ruptured and Crippled.

Doctor Hoguet, on October 7, 1925, made a free incision over the swelling, which, by this time measured 3½–4 inches in diameter, and protruded for about 2 inches beyond the normal surface of the skull. The tumor was soft, semi-fluctuating in consistence, and had all the characteristics of a hæmatoma. On cutting into it, the hemorrhage was very profuse, and the examining finger revealed complete destruction of both tables of the skull, the finger being able to pass down to the dura. The hemorrhage required tight packing, which was left in for nearly two weeks. On the second post-operative day, the patient was turned over to Doctor Coley for treatment.

Microscopical diagnosis by Doctor Jeffries: Spindle-cell sarcoma. Doctor Ewing's microscopical report stated: "Small spindle-cell sarcoma, very vascular; no bone formation, probably an osteogenic tumor arising from periosteum."

X-ray plates made before the operation showed complete destruction of both tables of the skull over an area 4½ inches in diameter. The patient was immediately put upon the mixed toxins of erysipelas and bacillus prodigiosus, systemically, the dose being increased up to 5 minims, which produced a reaction-temperature of 104–105, after which, an injection every other day instead of daily was given. The radium pack, consisting of 10,000 mc. hours was applied on October 21, and again on November 11, and on November 25, the three treatments totalling 30,000 mc. hours.

The soft part of the tumor rapidly disappeared, and the large cavity in the skull at the site of the operation filled in with normal granulations. The wound had entirely healed by the middle of December, and has remained healed since; there is practically no deformity at the present time; the patient's headaches have disappeared, and his general condition is good.

This case is not shown with reference to any effect of treatment—it is much too early to say anything as regards the prognosis—but is shown as an example of definite acute traumatic malignancy.

CASE II. *Osteogenic Sarcoma of Femur Following Trauma.*—I. L., male, twenty years old, chauffeur, was admitted to the Hospital for Ruptured and Crippled, March 13, 1925, with the following history:

In March, 1921, four years before, the patient's left leg was caught in the closing door of a subway train, severely squeezing the thigh. He was able to walk and did not notice anything unusual until three days after, when he began to feel severe pain in the thigh just below the great trochanter, at the site of the injury. The pain was intermittent at first, keeping him in bed for a few days at a time, but later the attacks became more frequent. A swelling

was noticed which gradually increased in size. He was admitted to the Jewish Hospital of Brooklyn, July 25, 1923, where an operation (osteotomy and curetting of bone) was performed August 7, 1923. Microscopical report: "Specimen consists of degenerated soft tissue in which there are embedded small pieces of sclerotic bone tissue. Microscopical diagnosis: Osteomyelitis of left femur." Physiotherapy treatment was begun in the latter part of 1924. A slide from the original specimen was obtained from the Brooklyn Hospital and submitted to Doctor Jeffries, who pronounced it productive osteitis. Doctor Ewing, who also examined the slide, concurred in the diagnosis and said that one edge of the specimen showed a slight suspicion of possible neoplasm, but not enough on which to make a diagnosis.

An X-ray picture taken two years ago showed nothing at all suggestive of sarcoma; there was a marked thickening of the femur with sclerosing of the bone, typical of a chronic sclerosing osteitis.

An X-ray picture taken on his admission to the Hospital for Ruptured and Crippled, two years later, showed that certain changes had taken place since the last picture was made: the bone was larger and thicker than it was at that time; the density seemed not quite so marked; instead of the periosteal line of the bone being intact, there were a few erosions in one area—a few indentations in the normal outline; apparently there was a small amount of new bone production beyond this normal line. The picture, however, did not permit one to make a diagnosis of sarcoma, although it was more suspicious of sarcoma than the earlier pictures.

The patient was admitted to the service of Dr. Royal Whitman (Hospital for Ruptured and Crippled), by whom an exploratory operation was performed March 16, 1925. On cutting through the muscle some soft, vascular tumor tissue was found which had broken through the periosteum.

Microscopical report by Doctor Jeffries: Mixed-cell sarcoma. Microscopical report by Doctor Ewing: Osteogenic sarcoma, polygonal cell, malignant.

The mixed toxins of erysipelas and bacillus prodigiosus were begun on April 1, 1925, and daily increasing injections were made in the buttocks, up to the point of producing a severe reaction, temperature of 103–104°, after which an injection only every other day was given. The treatment was kept up for nearly two months, the highest dose given being 15 minims. At the end of six weeks' toxin treatment, the circumference of the thigh had diminished two inches, and the patient's general condition had shown marked improvement.

Low-voltage X-ray treatment was begun at the Memorial Hospital by Doctor Herendeen on May 7, 1925; from then until November 13, 1925, he received seven exposures of sixty minutes each.

By June 18, 1925, he had gained 17 pounds in weight, and the leg measured the same size as the other one. He has remained in good health, and has gained about 35 pounds in weight since the treatment was begun. As far as the present X-ray pictures show, there is no definite evidence of sarcoma. Inasmuch as not quite a year has elapsed, it is much too early to say anything definite as to the prognosis. It should be borne in mind, however, that most cases of periosteal sarcoma show evidence of pulmonary metastasis at the end of one year.

This case was presented with special reference to traumatic origin rather than to results of treatment. In contradistinction to the first case, there was a long interval of time, nearly four years, before the neoplasm was recognized. The question arises, whether a sarcoma developed shortly after the injury

and progressed very slowly for several years before being recognized, or, whether a chronic osteomyelitis developed at the site of the injury, which, four years later furnished a favorable site for the development of a malignant osteogenic sarcoma. It is extremely difficult to decide which of these two theories is the correct one. In the present case, Doctor Coley was inclined to believe that the earlier process was an inflammatory osteomyelitis or productive osteitis which later furnished a favorable soil for the development of a sarcoma.

If we accept the theory that sarcoma and malignant tumors in general are due to a microörganism or virus—and personally he firmly believed that the research work of Glover, of New York, Nuzum, of Chicago, Young, of Edinburgh, and Gye and Barnard, of London, had practically proved this theory to be correct—then the question of whether the earlier condition in the foregoing case was an osteomyelitis or a latent sarcoma becomes one of academic interest solely; for then it would be a question merely of whether they are dealing with two different types of organism or a single one.

CASE III. *Periosteal Osteogenic Sarcoma of Femur.*—H. S., male, nineteen years old. Family history negative. In the beginning of 1920 he had a fall; one month later he noticed pain in the right popliteal space. This was regarded as of rheumatic origin and was treated with local applications. Two weeks later a swelling was noticed on the outer aspect of the femur just below the knee-joint; this steadily increased in size. The pain became very intense, necessitating two treatments with small doses of radium. He was referred by Dr. H. Hallarman, of New York, April 23, 1920, at which time he was admitted to the Hospital for Ruptured and Crippled.

On admission there was enlargement of the lower end of the femur most marked in the region of the outer condyle, extending to the popliteal space and upward for a distance of three inches. It was, apparently, of bony origin, firm in consistence, but not of bony hardness. The leg could be flexed almost to a right angle. The pain had diminished somewhat since the radium treatment. He was put upon systemic injections of the mixed toxins at once; these were given three or four times a week. At the end of three weeks, there was definite decrease in the size of the leg. The toxins were continued regularly until early July, when a slight increase in the size of the tumor was noticed. He was transferred to the Memorial Hospital where the radium pack was applied (total of 20,958 mc. hours) over two areas, at 6 cm. distance. He returned to the Hospital for Ruptured and Crippled and the toxins were resumed in doses up to 24 minims without marked reaction. While the tumor showed some diminution in size, the improvement was only temporary, and it again began to increase; there was considerable synovitis, and the X-rays showed an extension of the disease higher up in the femur with an increase in thickness and greater destruction of the dense tissue of the bone itself. The patient finally consented to an amputation, which was performed, just below the trochanter, in August, 1920.

Microscopical examination by Doctor Jeffries showed the tumor to be a "periosteal neoplasm, apparently originating in the popliteal region and extending nearly around the femur."

Microscopical report by Doctor Ewing: "Malignant spindle- and giant-cell osteogenic sarcoma. There is considerable production of osteoid tissue in marrow regions. Many areas of hemorrhage and some points of mucoid

degeneration appear. There are some broad areas of hyaline material without cells. Radium effects may be traced in the hemorrhages, mucoid degeneration, irregular calcification, and general hyperchromatosis of tumor-cell nuclei."

The man made a good recovery from the operation. The toxins were resumed and kept up with occasional intervals of rest for six months. He has remained in excellent condition up to the present time, January, 1926, five years later.

Doctor Coley remarked that this case, while a true example of acute traumatic malignancy, the symptoms developing one month after the injury adds one more to the very limited number of cases of osteogenic sarcoma that have recovered under any method of treatment and remained well for a period of five years. Doctor Coley has twenty cases of periosteal sarcoma, including five cases treated by other men under his direction, in which the toxins alone were used and the patients are alive and well from five to twenty-eight years later; in eight of these cases the limb was saved; in addition, he has fifteen cases treated with a combination of toxins and radium or X-rays that have remained well from four to fifteen years; in six of these cases the limb was saved. The present case, he believes, furnishes additional proof of the value of the mixed toxins of erysipelas and bacillus prodigiosus as a prophylactic after amputation. Doctor Coley stated that he had never succeeded in curing a case of osteogenic sarcoma by amputation alone, and Bloodgood has stated that amputation alone is able to cure not more than 1 or 2 per cent. of these cases. Therefore, Doctor Coley believes it of special importance to note that of thirty-eight cases of periosteal sarcoma treated by amputation followed by prophylactic toxin treatment, 50 per cent. have remained alive and well from three to eighteen years.

Dr. Walter A. Sherwood said that he would like some advice regarding a case he had now in the Brooklyn Hospital. This is an infant three months old, who came in with a deformity of the tibia resembling rickets. The radiographer interpreted the X-ray as bone cyst. Further study made it appear to be a bone abscess. It was thought advisable to investigate and the tibia was explored, the periosteum cut through and the cortex was easily entered. Some soft grayish-brown material was removed and the wound was closed. The material was sent to the laboratory for diagnosis and the report came back spindle-cell sarcoma. It had been assumed that amputation should be done but the mother had not consented, and as the speaker doubted the wisdom of an amputation in such a case, it was on this point he wished Doctor Coley's opinion. Doctor Sherwood showed a child at a meeting of this Society in February, 1923, who had an osteogenetic sarcoma of the humerus of intra-uterine origin. In this case disarticulation was done at the shoulder-joint and the child is now living and well, almost six years after operation. Sections of the tumor in the case were examined by Doctors Ewing, Bloodgood and Denton and the case is included in the Codman registry of bone sarcoma (No. 68).

Doctor Coley, in closing, stated that these cases were presented not so

much to exemplify the results of the treatment employed, but because of the growing medico-legal interest in the question of the traumatic origin of tumors. He stated that at present there was the greatest difference of opinion among surgeons and pathologists on the question of trauma as an etiological factor in the development of malignant tumors. Most surgeons have given the matter little consideration; and most pathologists claim that trauma plays little or no part. Doctor Coley believes no surgeon who has an opportunity of seeing a considerable number of bone sarcomas can fail to be impressed with the large number of cases in which there is a definite history of antecedent local injury. In an early report of 170 cases of sarcoma personally observed (ANNALS OF SURGERY, 1898), he had noted a history of antecedent trauma in 46 cases. In a later report (ANNALS OF SURGERY, April and May, 1911), covering a total of 970 cases of sarcoma personally observed, a definite history of trauma was noted in 225 cases, or in 23 per cent. It is interesting to note that the tumor developed within the first month after the injury in 117 of these cases. Doctor Coley stated that before the last meeting of the Southern Surgical Association in Louisville, he had presented a paper on "Injury as a Causative Factor in Malignant Tumors," with special reference to bone sarcoma. Since his publication of 1911, he had observed 117 cases of sarcoma of the long bones in which there was a definite history of antecedent local injury. In a group of 50 giant-cell tumors (reported in the ANNALS OF SURGERY, March and April, 1924) he had found a history of antecedent local trauma in 56 per cent. of the cases. The periosteal group showed a slightly larger percentage.

DOCTOR COLEY stated that Doctor Kolodny had read an important paper on "Bone Sarcoma" before the American Orthopædic Association in Washington last May; this was based on a study of twenty-five cases. This author found that the patients whose ages ranged from ten years and upward showed a history of antecedent local injury in 70 per cent. Within recent years, a number of cases have been tried before compensation bureaus and courts and the decisions rendered showed diametrically opposite opinions on the question.

Regarding Doctor Sherwood's patient, Doctor Coley said he believed amputation should be performed followed by several months' prophylactic treatment with the mixed toxins of erysipelas and bacillus prodigiosus. In a child of this age, he would advise beginning with one-half minim diluted with a little freshly boiled water. Doctor Coley stated that the youngest patient in which he had used the toxins was a child of two months with a sarcoma of the scapula, referred to him by Dr. V. P. Gibney. While in this case there was no microscopical examination, the tumor involved almost the entire scapula; it was of bony origin, apparently periosteal; the superficial veins were markedly dilated and the clinical and X-ray evidence left little doubt as to the correctness of the diagnosis. This patient was treated with toxins alone for nearly a year. He made a complete recovery and was alive and well more than six years later.

Later Note.—After the meeting was over, Doctor Coley made a closer

study of the pictures of Doctor Sherwood's case; in view of the location of the tumor (central portion of the tibia) and the absence of much new bone formation, he believed it to be probably an endothelioma, a type in which the limb had been saved in a number of cases by the use of the toxins alone or combined with radium. In this case, Doctor Coley believed it would be worth while trying conservative treatment for three or four weeks before amputating.

FRACTURE OF NECK OF FEMUR. RECONSTRUCTION OPERATION

Dr. William Crawford White presented a woman, fifty-one years of age, who was admitted to Roosevelt Hospital, May 11, 1923, with a subcapital fracture of the neck of the left femur. Under anæsthetic she was placed in an abduction plaster spica. The entire case was removed on the eighty-ninth day. A month later she went home on crutches. At the end of six months she began to bear weight on the limb. One year after the accident the X-ray showed much absorption of the neck. She had severe pain whenever she took a step; no voluntary flexion; with leg extended abducts 30 degrees. There was a shortening of about one inch. May 28, 1924, the Whitman reconstruction operation was followed, except that it was changed to a degree that a removable nail was put through the greater trochanter into the femur. Case removed at the end of forty-two days. Three months and a half later she walked with a cane; gradual improvement since. Now can walk a mile without discomfort. Flexes thigh none; abducts 30 degrees. The result is definite relief of pain and a little motion at the hip. She now does light work.

Dr. Royal Whitman said that he was, naturally, very much pleased to see such a convincing demonstration of the utility of the reconstruction operation for ununited fracture at the hip. He thought that non-union after efficient treatment by the abduction method indicated such impaired nutrition that direct union of the fragments by further operative procedure was extremely doubtful. In these cases and in all those in which the neck of the femur had been destroyed, the reconstruction operation was indicated because the result could be depended on, a result that even from the functional standpoint was as good, or better, than to be obtained by bone grafting, even if successful. He said he would like to correct what seemed to be the impression that he had claimed that union in fracture of the intracapsular type could always be obtained by efficient treatment. He thought union in such fractures might be predicted in the larger proportion of cases, and that all should be treated in a manner to assure the opportunity for success. Furthermore, since the transcervical fracture were in the minority, the prognosis in general, even from the functional standpoint, was now distinctly favorable.

Under the old system all varieties of fracture had been equally neglected, because it was assumed that one type was incapable of repair. He would conclude with a positive statement supported by both technical analysis and by comparison of results, that there was but one treatment for fracture of the neck of the femur and the only question was of the ability of the surgeon to apply it.

PLASTIC ON THE HEEL

Dr. James Morley Hitzrot presented a man, aged twenty-one, who was admitted to the New York Hospital, October 29, 1924, with a history of having had his right heel caught in an elevator. On admission it was found that the entire subcutaneous tissue had been stripped off the heel from the level of the malleoli down just beyond a line drawn through the base of the fifth metatarsal. The skin flap was stripped from the bone and on the outer side the sheath of the peroneus tendons had been opened. There were some small abrasions over the skin above the external malleolus extending about 2 cm. above the tip of the bone, and the edge of the flap contained ground in dirt.

The patient was taken to the operating room and the contaminated tissue excised, the wound thoroughly washed with saline solution and the skin flap loosely approximated around the heel. There was very little evidence of any vitality in the posterior half of this long flap. On the day after his admission the edges of the skin flap had become dusky and the whole flap gradually became bluish-black in color and had to be excised. This left a denuded area which practically involved the entire os calcis, and the sole of the foot as far forward as the base of the fifth metatarsal. The foot was dressed by the Carrel method with Dakin's solution until the 25th of November, 1924, when a plastic operation on the heel was done. The denuded area on the sole of the foot and heel was prepared by dissecting off the granulation tissue and freeing the skin edges down to the normal healthy granulation tissue. A flap of skin and subcutaneous fat was then dissected upward from the outer aspect of the left thigh, leaving a broad pedicle attached at its upper margin. The right heel was then placed across the left thigh and the pedicle flap, previously prepared, fastened over the denuded area on the right heel and fixed into position by interrupted silkworm and horse-hair stitches. The flap was so placed that it covered the sole and most of the heel, special care being taken to cover in the posterior and weight-bearing aspect of the os calcis. The denuded area from which the flap had been dissected was partially covered by a few Thiersch skin grafts removed from the opposite thigh and the denuded area dressed with vaseline gauze. Vaseline gauze was also placed over the skin flap and the right leg was fastened to the left leg by a bulky dressing and plaster bandage which extended about both legs, girdling them so that the foot was held fairly rigidly in position. The flap healed in position fairly rapidly and maintained its circulation except at one small area just below the external malleolus, where about one-half cm. of the flap dried up. Twelve days after the operation a temporary constriction was placed across the pedicle in order to ascertain whether the circulation was sufficient. As it seemed a little doubtful, it was left two days longer, when a temporary constriction was again placed across the pedicle and the flap seemed to retain its circulation. It was then detached from the thigh and attached to the denuded area by interrupted silkworm gut stitches. The flap healed without subsequent complications, except for a small blister in the skin just below the area beneath the external malleolus which had dried up. This skin bleb was opened and disappeared without further complications.

The patient was discharged from the hospital, December 2, 1924, with all the wounds healed except a small area just below the tip of the external malleolus, and this eventually healed and left the foot in approximately its present condition.

This case illustrates the method of placing a skin flap over the os calcis

which will permit of weight-bearing without the constant difficulty experienced with those cases which are skin-grafted. It also demonstrates the efficacy of the ordinary rubber sponge placed in the heel to compensate for the loss of the fat commonly present in the heel after flap transplant.

Habhegger (ANNALS OF SURGERY, 1908, vol. xlviii, p. 909) used this method, although Doctor Hitzrot was unaware of it at the time of his operation.

Doctor Hitzrot stated that he had used these methods in three cases, all of which have been quite satisfactory.

FRACTURE-DISLOCATION AT THE SHOULDER-JOINT

DOCTOR HITZROT presented a man, aged forty-two, who was admitted to the New York Hospital, June 9, 1924, with a history of having been

FIG. 1.—Fracture-dislocation of head of humerus.

knocked down by a horse two days previously. He landed on his right shoulder. The arm was immobilized by his doctor, who had an X-ray taken, which showed a fracture-dislocation of the head of the right humerus. (Fig. 1.) On admission to the hospital his shoulder was markedly swollen with a very considerable subcutaneous hemorrhage which extended over on to the chest. It was not possible to locate the head of the bone by the examination. The X-ray showed a subcoracoid dislocation of the head of the humerus with a line of fracture involving the greater tuberosity.

June 10, 1924, a four-inch incision was made over the anterior portion of the shoulder-joint, splitting the fibres of the deltoid muscle. There was exposed a fracture through the anatomical neck of the humerus, taking with it a small portion of the greater tuberosity and a portion of the bicipital groove. There was also a separate fracture of the greater tuberosity and the upper end of the lower fragment lay to the outside and above the head, which was displaced forward with its fractured surface resting against the edge of the glenoid fossa. (Fig. 1.) The subcapsularis muscle and the tendon of the long head of the biceps were wrapped around the displaced head. The subcapsularis muscle was divided after which it was possible to liberate the head. The head fragment was then found attached by the tendons of the supraspinatus muscle and was removed as the circulation was completely cut off. The divided supraspinatus attachment and the capsule of the shoulder-joint were then closed by chromic stitches and the end of the humerus placed in contact with the glenoid fossa. The capsule of the shoulder-joint had been torn loose from the glenoid fossa on its anterior surface, and no attempt was made to repair this rent but the excess of the capsule was sutured to the bone and to the capsular portion of the expansion of the supraspinatus tendon by interrupted chromic stitches. The greater tuberosity was fastened to the shaft by chromic stitches and the wound was closed without drainage, using silkworm in the skin and the arm put up in abduction to a right angle, with the forearm in sufficient external rotation to be parallel to the long axis of the body, in a suspension apparatus.

The man was instructed to move the arm on the day following the operation. He was out of bed on the second day after the operation, with the arm suspended and practiced shoulder movements within the limits of pain, lowering and raising the weight over the pulley. He left the hospital seventeen days after the operation with little or no voluntary motion in the arm. He was instructed to use the apparatus (suspension and weight and pulley) at home and in ten days (twenty-seven days after the operation) had about ten degrees of voluntary abduction and about five degrees of rotation each way. One month later this had increased and he was given exercises with dumb bells. Throughout the patient coöperated and made every effort to get as good a result as was possible.

June 21, 1925 (Fig. 2), a little over six months after the operation, he had reached his present function. The arm can be abducted alongside the head to within 10 degrees of the opposite arm. The arm can be extended in front of the body to within 10 degrees of the other arm. External rotation is less than the other arm by five degrees. Internal rotation is less than the other arm by 20 degrees. The man states that he uses his arm for everything he used to do just as well as he ever did, except that he cannot get it quite as far up on his back (loss of internal rotation). All the motions are shoulder-joint motion; the scapula does not begin to move any sooner on the affected side than it does on the normal, that is, the motion is not scapular motion.

Doctor Hitzrot presented a second case, in the person of a woman, who was admitted to the New York Hospital, December 16, 1925. Six days before admission she fell down a flight of stairs, injuring her right arm, which was immediately disabled. Her physician found the arm extremely swollen and was unable to determine the nature of the injury. X-rays were taken which showed a fracture-dislocation of the right shoulder with the head fragment in the subacromial region with the greater tuberosity split off as a separate fragment. On admission an unsuccessful attempt was made (by traction and suspension) to pull the fragments into position.

December 19, 1925 (nine days after the injury), a four-inch incision was made from the acromio-clavicular joint down the arm, splitting the fibres of the deltoid muscle. The upper end of the lower fragment lay below the glenoid fossa in the axilla. The head fragment lay posteriorly under the acromion process. The joint capsule had been extensively torn, especially on its lateral and posterior surface and the head had evidently been driven through this opening in the capsule. The greater tuberosity and a portion of

FIG. 2.—Seven months after operation.

the shaft with the attachment of the external rotators of the arm had been split off as a separate fragment and was displaced posteriorly and to a certain degree downwards in the relationship with the glenoid fossa. There were a number of other pieces of bone evidently split off from the shaft fragment. The head fragment was also broken and was so rotated that what normally was the anterior and inferior border of the bone had been completely turned around so that it faced upward and outward. It was completely loose and had no vascular attachment. The head was removed. The upper end of the lower fragment was smoothed off with a rongeur. The line of fracture apparently involved the quadrilateral portion of the bone before its expansion into the head. The greater tuberosity with the attached bone was then sutured to the shaft fragment by a few sutures passed through the tendon attachments

and the periosteum of the tuberosity and the peritoneum of the lower fragment. The upper end of the lower fragment was placed in the glenoid fossa in contact with the cartilaginous surface of the scapula. The capsule of the shoulder-joint was then loosely closed with interrupted chromic with some difficulty due to the extensive laceration and the subsequent infiltration of the tissue. The deltoid muscle was loosely closed with plain catgut and the skin with clips. The arm was put in external rotation with abduction to a right angle with the body and suspended in the overhead position.

The woman was started on active motion by means of pulleys, immediately after she recovered from the anæsthetic, within the limit of pain. She had a temperature reaction to 102 degrees on the day after operation, but this immediately came down and has not been up since. She continued to move the arm, increasing the range of motion each day. On the eighth day after operation the patient was allowed out of bed with her arm in a sling and was given instructions to move it as much as possible with the aid of the suspension apparatus. This she has been doing until the present time.

The case is now on the twenty-sixth day after operation. There is no voluntary motion at the shoulder except in very slight abduction and external rotation. On guided motion the arm can be abducted to a right angle with the body and through about one-half the normal arc of external rotation without moving the scapula. The case is shown as an early result and also as an uncommon form of fracture-dislocation of the head of the humerus.

These two cases were shown to advocate excision of the head of the bone and early active motion in fracture-dislocations of the head of the humerus. The essential points in the after-treatment are the effort, position of the arm and the use of the suspension apparatus with the pulley, and the movement of the arm by the patient. The original movements are essentially passive as the patient guides the arm or the weight with the opposite arm.

The first case Doctor Hitzrot considered a 100 per cent. result for this type of injury, and it was obtained very largely through the coöperation of the patient and shows very clearly how important a factor the willing effort on the part of the patient is.

Doctor Hitzrot has operated upon eighteen cases of fracture-dislocation of the shoulder in which the fracture line separated the head fragment through the anatomical neck or very closely followed that line. In these: two cases were replaced in the glenoid cavity and produced an entirely stiff shoulder. Doctor Hitzrot has also seen a similar result in a case done by Dr. Seward Erdman, and also a fourth case in consultation with Dr. A. E. Hoag. The head of the bone in all the above cases was surrounded by mushroom mass of bone with apparent calcification of a portion of the joint capsule and all the patients had painful stiff shoulders. Of the sixteen cases treated by excision of the head of the humerus and the procedure used in the two cases shown, four cases could not be found; of the remaining twelve cases—one is the case shown here and which is used as the 100 per cent. result and the other is too recent for a final rating. Of the remaining ten cases five had a 75 per cent. result of the case shown here and one had a 60 per cent. result and four had a 50 per cent.

Doctor Hitzrot also showed the lantern slide of a fracture-dislocation in which the line of fracture involved the upper one-third of the humerus below the neck and in which the dislocation was subcoracoid and stated that such cases could be reduced by a very simple open operation by grasping the shaft with a Lambotte forceps and replacing the head and then by subsequent treatment for the fracture.

By far the most frequent variety of fracture-dislocation is, however, found in the group shown by these cases and for that type Doctor Hitzrot wished to combat the statement that excision of the head was followed by a bad shoulder and that replacement of the head was the correct procedure.

Dr. Royal Whitman said that in fracture at the shoulder-joint motion was preferable to union and fixation. He thought therefore that in this case in which the head of the bone was completely detached it should be removed. Subsequent function depended largely on the range of abduction, and this was determined primarily by the preservation of the attachments of the scapular muscle and by supporting the arm in full abduction during convalescence.

CAVERNOMA OF THE THIGH

Dr. James M. Hitzrot presented a woman, aged forty-two, who was admitted to the New York Hospital, December, 1925, on account of a small swelling in the middle of the left thigh, accompanied by stiffness in the left leg and swelling in the left leg, which increased and became quite troublesome during her work. This condition she had first noticed four years previously and during that time she thinks the swelling has grown very slowly, has caused her no pain except the discomfort caused by the swelling of her leg after standing. The swelling of the leg has become more pronounced in the last two months and she thinks that the tumor in her thigh is also increasing in size.

Examination revealed over the middle aspect of the inside of her left thigh directly in the course of the femoral artery, a small irregularly-shaped mass, semi-solid in consistency, which is lifted up with each pulsation of the artery. There is no definite expansile pulsation. The tumor mass was not compressible and except on rather deep palpation was not tender. The entire left leg was swollen, the swelling being most marked between the tumor and the ankle, probably due to the fact that her shoe prevented the swelling of her foot. There were no palpable nodes in the left groin and her general examination was negative. The X-ray picture showed a mass of calcareous material in the soft parts well removed from the bone and in approximately the same region occupied by the tumor.

December 19, 1925, a four-inch incision was made along the inner aspect of the left thigh, exposing the tumor which lay directly on the femoral artery in the abductor longus fascia, where it begins to form the covering for the femoral artery. The tumor arose from the muscle tissue and had grown up around the artery so that the artery ran through a little grove in the base of the tumor and was compressed by it. The tumor was composed of a mass of venous tissue thoroughly encapsulated and with a number of calcified areas in it. The tumor was removed as a whole, dissecting it from the artery. The venæ comites were distinctly compressed, and after the removal of the tumor dilated. The saphenous nerve was also incorporated in the tumor mass and was dissected out without difficulty.

The patient made an uneventful recovery and left the hospital in eight days. The swelling in her leg had, when she left the hospital, entirely disappeared. There is still some disturbance in sensation in the distribution of the saphenous nerve.

Pathological report: Cavernous angioma with atypical proliferations of endothelial cells. Specimen consists of a small tumor-like mass of tissue 3½ x 3 cm. The specimen was removed from the femoral artery and on

one surface on the mass there is a groove through which the artery ran. Cutting the mass open shows it to be cystic in structure, the cyst having thick walls with deposits of calcium in them. The cyst cavity is practically filled with a fatty substance. A small amount of bloody fluid also was in the cyst. The cyst walls appear to be made up of muscle and fibrous connective tissue. Microscopic examination reveals an area of dense fibrous tissue with many dilated blood channels. At the age of some of these sinuses there is a mass of neurotic and calcific material. Another portion consists of very cellular areas apparently at the edge of a hyalinized vessel wall. These cellular areas are composed of spindle and rounded cells, closely packed together, bearing some relation to rather definite small spaces containing what appears to be necrotic material. Their location suggests an endothelial origin. Scattered through this cellular mass are small hyaline structures, the exact nature of which cannot be accurately determined. They may be areas of hyaline connective tissue, or possible muscle fibres. The encapsulation of this mass appears to justify the assumption that the process, although very cellular, is relatively benign.

Post-operative diagnosis: Cavernoma of the abductor longus muscle.

TRANSACTIONS

OF THE

PHILADELPHIA ACADEMY OF SURGERY

Stated Meeting Held January 4, 1926

The President, Dr. Edward B. Hodge, in the Chair

BILATERAL CHARCOT'S JOINT DISEASE OF THE ELBOW

Dr. Charles F. Mitchell and Dr. Walter Estell Lee presented a man, forty-four years of age, who was admitted to the Pennsylvania Hospital, December 10, 1925, complaining of swelling of both elbow-joints. His history is somewhat inaccurate but apparently during the summer of 1924, he was suddenly aware of chilly sensations and fever which were associated with pains in both elbow-joints. He says that these joints began to swell and in a short time were three times their normal size. They were red and very painful. The pain, however, was not limited to these joints but involved other portions of the body for a short time. With the disappearance of the general pain the swelling of the joints remained the same and ten days after this acute onset he says that the left joint opened spontaneously, although he also made the statement that it had been incised by a physician. The latter statement seems the most probable. A very few days after the left joint opened the same thing occurred on the right side. Since the opening of these joints and their more or less constant drainage the pains have subsided. The deformities which now exist have gradually developed.

He had a chancre, and gonorrhœa in 1907.

An X-ray picture taken December 16, 1925, shows typical Charcot's disease of both elbow-joints. The blood Wassermann reaction, taken December 18, 1925, was negative. A spinal fluid Wassermann reaction, December 20, 1925, was positive. A colloidal gold test of the spinal fluid gave a characteristic curve of tabes. Neurological examination showed the man to have all the classical signs of tabes.

The reporter added that although Charcot's neuropathic arthropathy may affect any joint in the body, it shows a strong predilection for the joints of the lower extremities, and the elbow is one of the rarer sites of the disease. In addition to this, it is exceedingly unusual for the disease to be bilateral. In fact, a rather cursory survey of the literature reveals but two examples, both affecting the hip-joints; the first, a patient from the United States Naval Hospital, League Island, reported by Doctor DaCosta (*DaCosta's Surgery*, 9th Edition, p. 605), the second, a case presented to the College of Physicians of Philadelphia in April, 1925, by Dr. Walter Elmer (*Transactions of Philadelphia College of Physicians*, 1925).

The incidence of Charcot's disease is mentioned in but few text-books. Ochsner, quoted by DaCosta in his text-book of surgery (9th edition, p. 604), states, "Of 947 cases the knee was affected in 394 (41.6 per cent.); the hip in 210 (22.1 per cent.); the shoulder in 128 (13.5 per cent.); the foot in 89 (9.4 per cent.); the ankle in 50 (5.2 per cent.); the elbow in 39 (4.1 per cent.); the hand 16 (1.7 per cent.); jaw 2 (0.2 per cent.); miscellaneous 19 (2 per cent.)." Lovett (*Keen's Surgery*, vol. ii, p. 35) states that the lesion occurs in 5 to 10 per cent. of tabetics and in a series of 268 cases affected the

lower extremities 207 times (77 per cent.). He gives the elbow as among the more unusual sites.

On account of the combination of two rare conditions in this patient—namely, a bilateral Charcot's disease of the elbow, it was thought justifiable to present it before this society.

DR. B. F. BUZBY said that he had under his care at the present time a patient with a double, but not symmetrical Charcot joint. A woman with Charcot joint of the foot and all the classical signs of tabes came under his care two years ago and was put immediately under anti-tabetic and anti-syphilitic treatment and given a brace for her foot and in the course of this treatment developed a Charcot knee on the opposite side which has progressed in spite of treatment. The advance of the foot condition has been stopped, however, at least temporarily.

CARCINOMA IN ADOLESCENTS

DR. CALVIN M. SMYTH, JR., presented a man, aged twenty-three years, who was admitted to the Methodist Hospital, November 4, 1924, in the service of Dr. Damon Pfeiffer. His chief complaint was vomiting, which he attributed to dietary indiscretion. At the time of admission his bowels had not moved for four days. He had no pain at any time prior to his admission. The previous medical history was essentially negative, except for the fact that he had always been more or less constipated. Examination showed a fairly well-nourished man of twenty-three. He was having violent hiccoughs and vomiting small amounts of brownish material at half-hour intervals. The heart, lungs, reflexes, etc., were all negative. The abdomen was distended and tympanitic. There was slight rigidity over the left rectus; no masses could be palpated. Peristalsis was very active. A rectal examination revealed a mass rather high, presenting into the pelvis from above. Proctoscopic examination showed a mass which was thought to be extra-rectal, but which seemed to be discharging into the rectum. The discharge was bloody in character. An X-ray examination disclosed an obstruction above the rectum with considerable dilatation of the rectum. The blood count showed no increase in the white blood-cells, the red cells and hæmoglobin were quite normal, and the blood Wassermann was negative.

November 10, the abdomen was opened through a right rectus incision. A mass about two inches in diameter could be palpated in the sigmoid about three inches above the recto-sigmoid junction, but could not be brought up into the wound. The sigmoid and descending colon were therefore mobilized by incising the lateral leaf of the mesentery and stripping through the midline. The right leaf of the mesentery was then cut along about one inch from the margin of the bowel and the sigmoid with its mesentery lifted from the hollow of the pelvis. This still gave insufficient mobilization for a Mikulicz operation, and the operation having progressed to this stage, it was determined to amputate the bowel below the growth. This was done, the bowel being divided between Payr clamps. The rectal stump was invaginated by a purse-string suture of linen thread. The proximal bowel was dissected upwards, clamping the mesentery close to the attachment to the bowel until about eighteen inches of the gut had been detached, with its mesentery. The denuded area in the pelvis was covered in by suture and a cigarette drain placed in the hollow of the sacrum. The upper portion of the bowel was drawn through a two-inch incision in the left rectus and fixed to the perito-

neum and to the abdominal wall. The bowel was then amputated with the cautery, two inches from the abdominal wall, and a Paul tube placed in the end. There was no immediate escape of gas or fæces.

The post-operative convalescence was most stormy. The hiccoughing very violent, the vomiting continued and the bowel did not drain well. November 12, two days after the operation, jejunostomy was performed, under local anæsthesia. This was followed by a violent reaction during which the temperature rose to 104.3, the pulse to 160, and the respirations to 45, but after a very trying week or ten days, he began to improve, and January 7, 1925, he was discharged from the hospital, equipped with a colostomy bag, and feeling very well. The pathologist's report of the mass removed was adenocarcinoma.

The man exhibited did not present the general appearance of one who had any metastases. He had gained weight and was able to attend to his usual duties. He discarded his colostomy bag about three months after leaving the hospital, and got along very well without it. He was able to attend to his colostomy himself, and by taking an enema the first thing in the morning he was able to go without any protection during the rest of the day. This illustrated the fact that colostomy life was not the living death that we have been led to believe in the past.

Doctor Smyth presented also a man, likewise aged twenty-three years, who was seen for the first time March 30, 1925. At that time he was complaining of "indigestion." His first symptoms appeared about three years ago, and consisted of a feeling of fulness in the epigastrium, heartburn and constipation. Under the use of antacids and carminatives his symptoms gradually grew less, and he enjoyed a period of comparative health until one year ago. His symptoms then returned. When seen by the reporter he was complaining of pain in the epigastrium which came on one to two hours after taking food. The pain was not relieved by alkalies, but was sometimes relieved by food. He was vomiting about once every two days, but had never vomited blood. He had lost about ten pounds in weight. The abdomen was not distended, but there was tenderness in the epigastrium, and slight rigidity. He had had tuberculous hip disease in childhood from which he had apparently made a good recovery. He had been operated upon for suppurating cervical adenitis five years ago, the scar of his incision being well healed and no evidence of recurrence being present. He was operated upon at the Methodist Hospital, June 1, 1925. The abdomen was opened through a right rectus incision. The peritoneal cavity contained a large amount of free fluid, blood-tinged in character. The stomach was drawn into the wound with some difficulty. There was a mass in the pyloric region about two inches in diameter, and about four inches long, very hard and nodular, and almost completely obstructing the pylorus. There was a stellate scar to the gastric side of the mass, which looked like a healed ulcer. There were many adhesions about the duodenum. The small intestine was studded with small hard nodules, and the pyloric and mesenteric glands were all enlarged and quite hard. The large intestine showed a similar involvement, although the liver was apparently free from metastasis. A palliative posterior gastro-enterostomy was done, and one of the glands removed for microscopic examination. The pathological examination confirmed the diagnosis of carcinoma. Apart from a little post-operative vomiting, which ceased after two gastric lavages, the patient made an uneventful surgical recovery. He was able to eat, had no pain, and was discharged from the hospital July 15. He died at his home, August 16, having been able to eat to within two days of his death, and at no time having had any pain.

This case is reported on account of the youth of the patient, the history and laboratory findings pointing to ulcer, and the operative confirmation of the existence of a healed ulcer.

Dr. Damon B. Pfeiffer reported having seen a case of carcinoma of the rectum at the age of sixteen. When he was confronted with the growth, it was impossible to resect and do an immediate anastomosis, for after mobilizing he was unable to bring it up far enough without undue tension on the distal end. He therefore cut the bowel just above the pelvic floor and turned in the lower end. He then made the colostomy and cut off the excess of associated mesentery. The growth was reported to be adenocarcinoma. No glands were involved.

Dr. John H. Jopson reported a case of carcinoma of the recto-sigmoid in a girl of twenty-five years, which he removed six months ago in two stages by the Jones technic. To-day she is in good health and able to earn a livelihood.

STRANGULATED INGUINAL HERNIA IN AN INFANT

Dr. Basil R. Beltran reported the history of a male infant, nineteen days old, who was admitted to the Misericordia Hospital, September 8, 1925. The child was well developed, weighing 9 pounds 12 ounces at birth and presenting no apparent abnormalities.

On the morning of its seventeenth day after birth the mother noted that he was rather reluctant to taking of food. Several times the milk regurgitated. Frequency and quantity of defecation lessened. No bowel movement or micturition was observed the afternoon of the eighteenth day. When seen shortly after admission the infant appeared greatly toxic. There was a marked restlessness accompanied by greenish vomitus, marked abdominal distention and a scrotal swelling about the size of a large English walnut (5 cm.). The mass was bluish, doughy and well circumscribed, the upper margin ending abruptly at the inguinal ring. No attempt was made to perform taxis, but immediate operation was done.

An incision over the left scrotal and inguinal regions was made under local infiltration anæsthesia (novocaine 0.5 and adrenalin 0.25). As the peri-peritoneal structures were cut through, the tense congested gut was distinctly visualized. With great difficulty the fibrous external inguinal ring was incised. Immediately the scrotal peritoneum tore through due to the distended small intestine. Then owing to the infant's constant straining about 7 cm. of normal gut escaped through the opening. The sac contained about 5 cm. of livid small intestine. The glistening of the surface was faintly apparent. Following the application of warm compresses, evidence of returning circulation became marked. Repeated efforts to now reduce the intestines were futile, so for a few minutes which included tying of the peritoneal sac and reduction of intestines, ether was administered. Owing to the great amount of surrounding œdema and delicateness of the tissues it was with difficulty that a successful attempt was made to partially close the canal with chromic gut No. 0. The time of the operation, including infiltration, was thirty-five minutes. Though the pulse was imperceptible and respiration exceedingly rapid, the infant was but slightly cyanotic on leaving the table. The following morning, five hours and again seven hours after operation the infant had copious bowel movements of dark brown fluid. Defecation then progressed at irregular intervals, allowing the child to return to normalcy. The mother was allowed to nurse the babe eighteen hours after operation. The wound

healed by primary intention. Convalescence was rapid. No complications ensued. The patient left hospital twelve days after admission. In this case the strangulation lasted thirty-six hours or more.

The youngest case on record operated upon for strangulated hernia with recovery appears to be that of Woodbury's in 1874. The infant was forty-five hours old when operation became imperative. Collins,[3] in his paper in 1913 on the subject of hernia in infants, has covered the literature most thoroughly up to that time. After reporting his case of eighteen days he mentions various domestic and foreign observers as having reported cases eleven days to six months old, that were operated upon for strangulation with recovery. Our present remarks are confined to cases not more than one month old.

A. Ceballos,[1] in 1912, reports a child operated upon when eighteen days old. G. Brown,[2] in 1913, one, one month old. E. C. Hall,[6] in 1913, one, twenty-one days old. W. E. Lee,[7] in 1914, one, twenty days old. A. A. Matthews,[8] in 1914, one, thirteen days old. I. M. Guillaume,[5] in 1915, one, fifteen days old. J. E. Fuld,[4] in 1919, one, fourteen days old.

There may have been others recorded, if so, they have escaped the author's attention. Monihan's tables quoted by Carmichael show strangulation to be the most common during the first month of life and gradually less frequent up to one year. Strangulated inguinal hernia in very early infancy while rare is not rare enough to be disregarded as a possible entity in the etiology of conditions occurring at that period.

The symptomatology of strangulated hernia in babies differs greatly from that of adults, due to the lack of subjective signs and the greater tendency to collapse. Objectively are to be noted marked restlessness and crying, recurrent vomiting (often fecal in character), constipation accompanied by abdominal rigidity and distention, and a tendency to retention of urine. Locally a swelling is present that may be either hard or soft.

With an accurate history and the persistency of the above signs showing a tendency to rapid collapse, the diagnosis is made. However, there are a few stumbling blocks along the diagnostic way, the more common being an ectopic testicle, a hydrocele and inguinal adenitis. Hydrocele may be eliminated by the serious aspect of the rapidly increasing symptoms in strangulation. Transillumination should never be considered, for hernia in early infancy may be translucent. Inguinal adenitis if unilateral is nearly always a secondary condition, due to abrasions or contusions on the side involved. If bilateral then the child may be the victim of general adenopathy the result of heredity.

Delayed intervention is unquestionably responsible for the fatalities. The recoveries in a great many instances are due to the marked recuperative tendencies of infants, but this quality should not suggest procrastination.

In the treatment too much emphasis cannot be laid upon the avoidance of prolonged or vigorous taxis. In the presence of strangulation operation is demanded. As far as possible, as in the case reported, a local anæsthetic should be used. If the intra-abdominal tension should become so great as to prevent intestinal reduction, then let a general anæsthetic be given so as to allow reduction and closure of the sac. The operation is continued under local infiltration. As to the manner of suture, the simplest method, consistent with the severity of existing conditions should be used. To transplant the cord is unnecessary. Simple suture of the soft parts and closure without drainage is all that is desired. Care is especially taken to prevent inversion of the incised skin edges.

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Dr. John H. Jopson stated that he assisted the late Doctor Wharton to operate on a child about fourteen days old. He himself had operated in two or three cases a month old.

RETROPERITONEAL TUBERCULOUS LYMPHADENITIS

Dr. Isidor S. Ravdin read a paper with the above title.

Dr. De Forest P. Willard said that a certain number of these cases of retroperitoneal tuberculosis come under the attention of the orthopædic surgeon and give a little different symptoms than those described. In these children the symptoms strongly simulate Pott's disease of the lumbar vertebra. In these cases psoas abscess symptoms are the ones which usually predominate; they usually have backache, dull pain, a certain amount in spine, but with a distinct mass in psoas region. In several cases which have been followed closely they have shown no sign of spinal tuberculosis. Under the treatment of rest, physical therapy and so on, these cases have reabsorbed the abscesses and have cleared up. One case in which abscess occurred, became so large that fearing rupture it was opened. At that time the abscess was unquestionably a tubercular one, there was no sign of a bony involvement, tissue taken from the depth of the abscess mass revealed under the microscope some broken-down lymph tissue, so they felt the diagnosis of lymphadenitis was correct. It very closely simulates spinal tuberculosis and the ordinary psoas abscess of Pott's disease.

PSEUDO-PANCREATIC CYST FOLLOWING CHOLECYSTITIS

Dr. Henry P. Brown, Jr., gave the history of a man of thirty-seven years, who was admitted in Dr. John H. Jopson's service at the Presbyterian Hospital, November 23, 1923, complaining of pain in his upper abdomen. He stated that four days previous he was awakened with severe cramp-like pain in his abdomen which was generalized in character. He took magnesium citrate and castor oil and the purgation which followed afforded him some relief. At this time he induced vomiting. Subsequent doses of oil and attempts to vomit did not improve his comfort and on the day of admission to the hospital he had been vomiting continuously and had constant abdominal pain with acute exacerbations which he described as being "knife-like." From his description the vomiting had been projectile in character but not fecal. He had been belching gas but had not passed anything by bowel for twenty-four hours, in spite of five enemas and eight drinks of whisky. He said that he had had a similar attack one year ago which lasted one day. There were no urinary symptoms and nothing in the history suggestive of gastric ulcer.

Physical examination showed a very obese man apparently suffering acute pain. The head, neck and chest with their contents were essentially normal, the abdomen somewhat distended throughout and slight tenderness in the mid-epigastrium. There was no tenderness or rigidity over the appendiceal or gall-bladder regions and peristalsis was not heard, probably due to the thickness of his abdominal wall. The admitting resident physician made tentative diagnosis of acute intestinal obstruction, acute pancreatitis or acute cholecystitis. The patient was placed in the Fowler position and given sodium bicarbonate and glucose by bowel.

The temperature, pulse and respiration were 98.2—76 and 22. Urine showed specific gravity of 1036 with a trace of albumin, no sugar, a few hyaline casts and mucus. The blood examination showed 4,860,000 red blood-cells, 11,000 leucocytes and 96 per cent. hæmoglobin. The blood Wassermann was negative.

Three days after admission his pain had disappeared, his scleræ were bile-tinged and his temperature, pulse, and respiration were 100.4–108 and 24. Four days later, the jaundice having disappeared and his urine being clear, his leucocyte count being 9000, he was operated upon by Doctor Pfeiffer, using nitrous oxide-oxygen-ether anæsthesia.

The peritoneum was opened through a mid-right rectus incision and the appendix delivered. It was apparently normal and was removed. Examination of the gall-bladder showed it to be so much inflamed that it was deemed best to remove it. This was a rather difficult procedure on account of the depth of the patient's abdomen. The cystic duct was isolated and ligated and the gall-bladder stripped out of its bed in the liver, the raw surface of the latter being covered with catgut sutures. A cigarette drain and rubber tube were inserted for drainage and the wound closed in layers. No mention is made in the operative notes as to the condition of the pancreas. The patient left the table in good condition, the duration of the operation having been one hour and forty minutes.

The drains were both out on the seventh day and the sutures were removed on the eleventh. On the following day the wound opened down to the fascia throughout its entire extent and Dakinization was started. At this time he also had projectile vomiting and eructated a considerable amount of gas.

On the fifteenth post-operative day he began to drain bile freely from the wound, the vomiting was less and he was more comfortable, his temperature varying from normal to 101°. He was discharged January 19 in good condition, wearing an abdominal belt.

The laboratory reported chronic diffuse appendicitis and chronic diffuse and suppurative cholecystitis. The gall-bladder showed the lumen entirely filled with cusped or faceted stones, varying from minute to about 7.5 mm. diameter. The entire mucosa was a mass of acute inflammation and cross-section of the wall showed a moderate degree of inflammatory action.

He was readmitted to the hospital fifteen days later, sixty-six days after his cholecystectomy, complaining of a tumor in his upper abdomen, and sent to Doctor Allen's service, to whom the reporter is indebted for the privilege of operating upon and reporting this case. He stated that during his convalescence he had noticed an increase in the size of his abdomen, especially of the upper part. This had been gradual in character and thus far had caused no discomfort whatsoever. His appetite was good, his bowels regular, and he had no gastric, cardio-pulmonary or renal symptoms. The temperature, pulse and respirations were normal. The urine showed a few hyaline casts and a very faint trace of albumin and the blood count was: red blood-cells, 3,580,000; leucocytes, 10,200; hæmoglobin, 70 per cent.; polymorphonuclears,

86 per cent.; large lymphocytes, 10 per cent.; small lymphocytes, 14 per cent. A diagnosis of cyst of the upper abdomen was made and he was operated upon eight days later.

The previous operative scar was sterilized with iodine and covered with a rubber dam, bound down with adhesive. The peritoneum was exposed by means of a high left rectus incision and upon opening it the lower border of the stomach and gastro-colic omentum appeared in the wound. There was a large cyst of the upper abdomen and this was tapped by means of a trochar and canula thrust through the gastro-colic omentum, the fluid being allowed to escape quite slowly. Five quarts of straw-colored fluid were removed from the cyst and the incision then enlarged sufficiently to admit the hand. A handful of pasty brownish necrotic material was removed from the bottom of the cyst. The cyst wall was then marsupialized to the abdominal wall. A large drainage tube was inserted and the abdomen closed in layers. He left the operating room in good condition and made an uneventful recovery.

The drainage was profuse for twelve days, at the end of which time the notes state that there is practically no fluid aspirated from the cyst, it is nearly closed, and the drainage tube is inserted with difficulty. The discharge caused excoriation of the skin, so that it was necessary to use boric acid strips and zinc oxide to protect it. The incision became slightly infected, but soon cleared up under treatment, and he was discharged to the Surgical Dispensary for dressings on the thirty-third day after operation.

The diagnosis was hemorrhagic pseudo-cyst of the pancreas.

The fluid removed from the cyst showed a sterile culture: 1.5 per cent. albumen and many red blood corpuscles. Later examination, sixteen days after operation, showed no lipase, trypsin or amylase. Staphylococcus aureus and B. coli were present. Smear showed 85 per cent. polymorphonuclears and 15 per cent. lymphocytes. The blood sugar was 93 mgm. per 100 c.c. of blood.

Microscopic examination of tissue removed at the time of operation showed fatty and connective tissue necrotic throughout with areas of fat necrosis and diffuse hemorrhage.

When seen October 24, 1925, both of the abdominal incisions were entirely healed, there was no evidence of recurrence of the cyst, he said that he was in splendid health, and regarded himself as entirely cured.

The reporter added that in reviewing the recent literature on pancreatic cyst following acute infections of the gall-bladder he had found only one case similar to the above. This was reported by Ballin and Saltzstein in the *Journal of the American Medical Association*, vol. lxxvi, No. 22, page 1484. This was a man of forty-six years who had had several acute attacks of upper abdominal pain. At operation a gangrenous gall-bladder filled with stones was removed. Pain recurred shortly after leaving the hospital and he was re-operated upon two and one-half months after the first operation. At that time a pancreatic cyst was found from which four quarts of brownish fluid were removed. Amylase was present and active and trypsin was present but weak.

In discussing this case they bring out the fact that stasis and infection are closely related in disease of the gall-bladder and associated pancreatitis. Nordman, quoted by the above authors, showed that in dogs, when the papilla of Vater was closed by a ligature, thus allowing bile to flow into the pancreas, he could not produce pancreatitis. If bacteria were then injected into the gall-bladder pancreatitis was produced, though the injection of bacteria without ligating the pancreatic duct produced no result.

The case reported by Ballin and Saltzstein and the one here recorded have apparently the same underlying pathology, namely: 1. Acute cholecystitis and

cholelithiasis with severe concomitant pancreatitis. 2. Cholecystectomy followed by some interference with the biliary flow. 3. Recurrence and accentuation of pancreatic inflammation with breaking down of pancreatic tissue followed by leakage of pancreatic secretions and bile into the lesser peritoneal cavity forming a cyst.

Dr. Damon B. Pfeiffer said that he recalled this case distinctly because of the operative complications. He was sure that he examined the pancreas at the time of the cholecystectomy, and was unable to note any particular abnormalities. Certainly he had no cyst there, or fat necrosis, or any of the recognizable evidences of pancreatitis. The diagnosis of pancreatitis was considered even before operation, but he was unable to verify this. Rupture of the wound followed the unwise removal of through-and-through sutures in a corpulent man, who was considerably distended, the wound breaking down all the way to bowel. He had a pretty desperate condition of affairs for some time. Though he had this extensive suppuration of his abdominal wall, he has absolutely no hernia.

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ANNALS of SURGERY
227-231 So. 6th Street
Philadelphia, Penna.